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THE INVENTION OF THE STRIPPER.

FOREWORD BY Hon. F. J. S. WISE, M.L.A., MINISTER FOR AGRICULTURE.

I appreciate the privilege of writing a foreword to this work of Dr. G. L. Sutton, which, after much patient research and well-ordered thoughtfulness in the arrangement of the facts, has resulted in establishing beyond doubt that John Wrathall Bull invented the fundamental principle of the Stripper.

It appears remarkable that it remained for one not of South Australia to probe into the happenings of nearly 100 years ago, and to maintain sufficient unbiassed interest to establish the facts as they are progressively set out in this entertaining and interesting story. The article itself will show that only a practical agriculturist would have been capable of appreciating and interpreting the mass of evidence which his own researches accumulated.

Dr. Sutton had no axe to grind — he realised the importance of giving credit where credit is due — and not in any one sentence has he suggested that John Ridley should lose the credit of having manufactured Australia's first Stripper.

The story as progressively unfolded also suggests the desire—and the necessity—to establish with accuracy all of Australia's creditable performances. Had this work not been undertaken and carried to this conclusion it is possible that John Wrathall Bull would have gone down in history as an impostor.

A nation responsible for the Stripper, the Torrens Title, the Combined Harvester, and the Stump Jump Plough has no apology to make, and in the interests of all of the past, present, and future, it is desirable that the truth in connection with all such creditable contributions should be fully recorded.

The American writer, Henry George, shortly after the first Stripper was invented and manufactured, wrote: "He who sees truth let him proclaim it, without asking who is for it or who is against it." It was in this spirit that Dr. Sutton entered into his great task, and he must feel considerable satisfaction in establishing for two of Australia's early sons the credit due and the important parts they respectively played in "The Birth of the Stripper."

THE INVENTION OF THE STRIPPER.

GEO. L. SUTTON, Director of Agriculture.

Its story as disclosed by a study of relevant documents and particularly of the files of newspapers published at the time of its invention, manufacture and introduction.

I.—Introductory.
II.—The exhibition of the "Reaping" machine models, Adelaide, Sept., 1843; J. W. Bull's "comb and beaters" model.
III.—Failure of John Ridley's reaping machine, Oct., 1843; success of his stripper, embodying the "comb and beaters," Nov., 1843.
IV.—Early popular misconception of Ridley's part in the discovery of the essential principle of the stripper as distinct from its practical application.
V.—Contemporary evidence supporting Bull's claim as the originator of the essential feature of the stripper, the "comb and beaters."
VI.—Bull's claim for recognition, 1845.
VII.—Ridley's silence.
VIII.—Press discussion of Bull's claim revived 1875 and 1879.
IX.—Further controversy, 1886.
X.—Miss Annie Ridley's argument in "A Backward Glance," 1904.
XI.—A later champion of Ridley: Stephen Parsons—John Ridley a Public Benefactor.
XII.—Conclusions.

I.—INTRODUCTORY.

On 3rd April, 1936, a broadcast talk was given by me from the National Station, 6WF, Perth. It was entitled "The Birth of the Stripper" and dealt with the invention of that unique and wonderful harvesting machine, "the Australian Stripper." In that broadcast its invention was ascribed to John Wrathall Bull, but during a visit to Adelaide in July of the same year it was learned from the Archivist, Mr. G. H. Pitt, that this view was not accepted universally and that some years previously there had been a serious newspaper controversy in the Adelaide press regarding the respective claims of Bull and Ridley for the honour of having invented the "stripper." In this controversy Mr. Stephen Parsons had been the chief protagonist for Ridley, and he wrote me on September 1st stating that he had seen a reprint of my broadcast address in the Adelaide "Stock and Station Journal" of August and that it was incorrect for me to state that Bull was the inventor of the stripper, as its inventor was John Ridley. He requested that the necessary and proper correction be made. In support of his contention he forwarded a pamphlet which he had written supporting Ridley's claim.

After reading the pamphlet, it was not considered advisable to alter the original statement without further inquiry, as the views expressed in the broadcast address had been based upon the statements made by J. W. Bull in his book "Early Recollections and Experiences of Colonial Life," and there was reason to believe that they were founded on fact as in its preface, by J. P. Stow,* it was stated "there can be no doubt as to the value of the work as an accurate record of events." Further, in 1882 Parliament had made a grant of £250 to Mr. Bull for the improvements he had made in harvesting machinery.

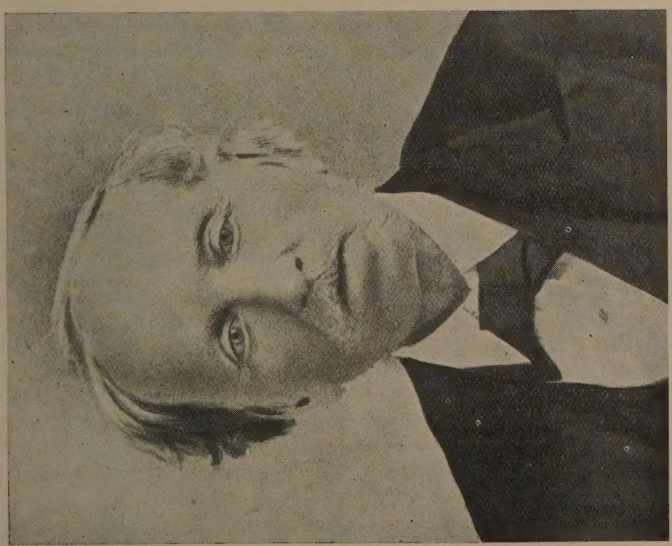
To determine the soundness or otherwise of the respective claims it was decided to obtain, if possible, unbiassed evidence regarding them or regarding their respective merits. A perusal of many of the letters which were published in connection with the Bull-Ridley controversy served to confuse rather than

* J. P. Stow was the Editor of the Adelaide "Advertiser" from 1876-1883, and the author of a book entitled "South Australian History—Production and Natural Resources."

clarify the issue. In consequence, arrangements were made to examine any relevant documents available, including the old files of the newspapers which were published about the time the first stripper was made and tried. Files of

THE TWO MEN WHO RENDERED CONSPICUOUS SERVICE TO AUSTRALIA BY THE INVENTION AND INTRODUCTION OF THE "AUSTRALIAN STRIPPER."

JOHN RIDLEY.
The maker of the first Stripper.



JOHN WRATHALL BULL.
The inventor of the fundamental principle.

the "South Australian Register." "The Adelaide Observer" and "Southern Australian" of that period, which were in the Barr-Smith Library of the University of Adelaide, in the South Australian Public Library, and in the Mitchell Library of Sydney, were courteously made available to and studied by

me, during periodical visits to the two cities. Those in the Adelaide Libraries were also made available to Mrs. Koch, a granddaughter of J. W. Bull and who, as she resided in Adelaide, was able to examine the files there at any time. Mrs. Koch has been of great assistance in this investigation, especially in making extracts from the files for my perusal.

The historical details hereunder regarding the invention and introduction of the "Australian stripper" are based upon a study of the newspaper records and some original documents which are referred to later.

Excerpts from newspapers and other documents which are relevant to, and which have been used in this investigation, will be found in appendices. A number in parentheses as (1) in the letterpress is the number of the appendix in which the related reference will be found.

II.—THE EXHIBITION OF THE "REAPING" MACHINE MODELS, ADELAIDE, SEPTEMBER, 1843; J. W. BULL'S "COMB AND BEATERS" MODEL.

The story of the "stripper" starts in 1843. In that year, with the area cropped to wheat rapidly expanding, those interested in the development of the young Colony of South Australia were very much concerned with the shortage of labour with which to harvest the crops. In this connection a letter appeared in the "South Australian Register" (1) from "Agricola" calling attention to the shortage in the labour likely to be available for the forthcoming harvest, and urging the inventive to devote attention to the construction of a reaping machine. This letter undoubtedly represented the current opinion. So acute was the shortage of labour, that arrangements were made for the 150 soldiers who had been brought from New South Wales (2) at the request of Governor Grey to be released from their usual peace-time duties so that they might assist in harvesting the wheat crop of the Colony. The number of men, however, required for harvesting purposes was much greater than was available. The necessity of the time, therefore, forced attention upon the possibility of harvesting the wheat crops by mechanical means.

The introduction of Bell's reaping machine in Scotland a few years previously, in 1828, gave encouragement to the idea that the construction of a harvesting machine suitable to the needs of the Colony was possible, and with consequent considerable reduction in the need for additional manual labour. It was obvious to every interested and thinking person that unless some harvesting method more expeditious than by manual labour, could be found, the development of the wheat lands of the Colony must either slow down or cease.

This desperate state of affairs was naturally of great concern to the Governor and leading men of South Australia. Arising out of it a group of men, including some farmers, who were in the habit of meeting together at Payne's Hotel (later to be known as the Exchange Hotel), formed what they called "The Corn Exchange Committee," or the "Market Committee." The self-imposed function of this committee was to encourage those with mechanical or inventive ability to produce a reaping machine in time to deal with the next harvest. Their object became known and considerable interest was aroused in the possible invention and construction of such machine.

Each of the three papers wrote leaders on the subject (3-6) thus indicating the general interest in it. It is evident from their comments that the editors knew some, if not most, of the possible exhibitors. Allen, the editor and proprietor of the "Register" took a special interest and showed this by making a model for exhibition. In order to ascertain the extent of the public interest, the Committee, early in September, 1843, decided to call a meeting of those who

had either plans or models for a mechanical means of harvesting the coming harvest (7).

The meeting as advertised was held on the 12th of September. From a report of it recorded in the "Southern Australian" of 15th September, 1843 (8) it is learnt that the sum of £40 was offered as a prize or award to the successful exhibitor.

According to a report in the "Observer" of the 16th September (9) the names of the known inventors were read out at the meeting; these were:—Messrs. Allen, Marshall, Robertson, Coutts, H. W. Phillips*, Thornber, Murray, Ridley, Owen Smith, Hall, King and Francis. Neither Ridley nor King was present. The latter was represented by Emmett and an unnamed friend announced that Ridley was constructing a machine which would thrash the grain as well as reap the crop (10).

Some models and plans were exhibited but, after discussion, the Chairman—Alderman Peacock—adjourned the first meeting until the following Tuesday evening. The business was re-opened then and occupied the evenings of Tuesday 19th, Wednesday 20th, and Thursday 21st. The "Observer" of the 23rd records that at these meetings five other exhibitors or their representatives attended and displayed either plans or models. These were Messrs. Bull, Herbert, Pitcher, Swingler and Dr. Cotter (represented by McDougall). It is not quite clear whether there was not another exhibitor named Auld, for in the "Southern Australian" of 15th September reference is made to an exhibitor of that name (11); it is believed, however, that the word "Auld" is a misprint for "Hall."

Thus, there were seventeen prospective inventors interested in the making of a harvest machine, and who either attended in person or were represented at one or other of the meetings held during the weeks commencing the 10th and 17th September.

After holding four meetings and examining the models and designs submitted the Corn Exchange Committee refused to make the award, but considered that Swingler's design had sufficient merit to justify them in making a grant of £3 for the construction of a model. This decision was conveyed to the public in the form of an advertisement (12) in the "Observer" of the 23rd September, and as a report in the "Southern Australian" of 26th September (13). In the advertisement (12) and in the report (13) it is to be noted that the number of exhibitors named is thirteen only, whereas in the letterpress of the "Observer" of the 16th and 23rd September (the same date as the advertisement (12)) there is a comprehensive report of the proceedings, and this shows that, excluding Ridley, there were sixteen exhibitors. The names of the exhibitors included in the letterpress of the "Observer" of the 16th and 23rd September and omitted from the above advertisement and report are Allen, Coutts, Thornber. Allen exhibited at the first meeting on the 12th September, 1843, but not subsequently. In the "Southern Australian" these exhibitors are loosely called inventors.

In the "Register" of the 23rd September (14) there was published a description of Swingler's exhibit in the form of a letter written by him on behalf of himself and his partner, Harding.

After inspecting a model made by Swingler, the Committee decided to call a meeting with the object of collecting donations for the purpose of having a full-sized machine made. A report of this meeting is given in the "Register" of 7th October, 1843 (15).

* There is some doubt as to whether the initials of exhibitor Phillips were H. W. or Chas., as in the "Observer" of 16th September his initials are given as H. W., and in the account in the paper of the 23rd his Christian name is given as Chas. In the advertisement appearing in the "Observer" of the same date announcing the decision of the meeting he is referred to as Chas. Phillips.

From a report in the "Southern Australian" of the 17th October, 1843 (page 2, col. 2) it is apparent there was a difference of opinion between Swingler and the Committee, for it was decided to abandon the plan of building a machine on the lines of Swingler's model, and to devote the money collected to building a machine according to Murray's design, provided his estimates as submitted were not exceeded.

Swingler and his partner were so satisfied with the merits of their machine, and so sure of its ultimate success, that they decided to undertake its manufacture on a commercial scale. Their advertisement to this effect was inserted in the "Observer" of the 14th October (16). Evidently the machine was not a success for no later reference to it could be found by the writer other than an announcement (17) on 4th November to the effect that it was understood that Swingler's machine would be ready for work early the next week, and a reference to it and Murray's machine on the 18th November (17).

The full text of an article referring to Bull's model appeared in the "Observer" of the 23rd September, 1843 (18). The relevant description is: "His machine consisted of a long-toothed comb, fixed to the back of a close-bodied cart; the teeth being operated upon by four revolving horizontal beaters, with square edges, which would have the effect of taking off the ears of corn, and depositing them in the body of the cart, a wide bag being placed under the after part of the comb to catch any dropped grain."

Descriptions of such of the other exhibits as were considered by the Press to have warranted comment are to be found in the issues of the "Observer" of 16th and 23rd September. Relevant details will be found in appendix (19). It is to be noted that, with the exception of that of Bull, all these, including that of Swingler, were intended to *cut* or *reap* the crop.

Though Ridley did not exhibit either a model or a design, and therefore was neither an exhibitor nor a competitor for the award of £40, he was present at the meeting on Wednesday, 20th September, and probably at one or other of the meetings held in that week; at the Wednesday meeting he then announced that he had under construction a reaping and threshing machine which would be completed shortly. He invited members of the committee to inspect it (20). It is on record that the invitation was accepted by several persons,* though none of them, as far as can be found, wrote a description of it.

Fortunately, however, Ridley himself described on the 1st September, 1843, a machine he had in mind in a letter which appeared in the "Register" over the pen name of "A Wheat Grower" (21)†. It will be seen from this description that Ridley's proposed machine was a reaping or cutting machine, for which purpose a projecting row of prongs with cutters was to collect and detach the head of grain, which were then to be thrashed. A press notice in the "Southern Australian" of the 26th September (26) stated that Ridley's machine "will beat off the ears, thrash and winnow at the same time." Unless the phrase "to beat" is a misprint for "to reap," then the intention was obviously to beat off the heads, or beat out the grain from them by means of the "scutchers" on the thrashing drum.

The plan of reaping the crop proposed by all the prospective inventors, except Bull, was in accordance with the general practice of the time. The custom was to cut or reap the crop with a sickle or scythe before it was quite ripe. The cut plants were bound in bundles or sheaves and allowed to mature

* Ridley, Annie E., "A Backward Glance" (1904), p. 382.

† There is ample evidence that "A Wheat Grower" was Ridley. This is furnished by editorial references to it which appeared in the "Register" 16th December, 1843 (36), the "Southern Australian" of 21st March, 1845 (49), and in a letter under Ridley's own name which appeared in the "Register" on 6th May, 1886 (72).

thoroughly in stooks and then thrashed, either with or without an intermediate period in a stack. With the exception of Ridley and Bull the others proposed to follow the conventional practice and reap the crop before it had reached full maturity. Ridley and Bull broke new ground in that they both proposed to deal with the crop when fully mature. Ridley proposed to reap it or detach the heads at maturity by means of a set of sharpened prongs, in accordance with the practice of the ancient Gauls, as described in Loudon's Encyclopaedia of Agriculture (22). He then proposed to thrash the grain from the heads and winnow it by removing everything but the grain. Such a machine as proposed was in effect the modern Reaper-Thrasher, which was not introduced into agriculture in California until 1860 and into Australia not until 1910.

Bull's proposal for dealing with the thoroughly matured crop was an advance upon Ridley's plan in that he proposed to dispense entirely with the operation of reaping, and to thrash the grain from the crop as it stood in the field. He proposed that the wheat stalks should be held just below the ear by a number of gatherers resembling the teeth of a gigantic comb, and that the ears, when so held, for the moment, should be struck by a bar and the grain beaten out as by a flail. As the result of the force and speed with which the ears were struck they would be broken off and carried with the thrashed grain into the body of the cart or machine to which the "comb" and "beaters" were attached. Thus was the idea of the "comb and beaters" brought under public notice for the first time. Bull's proposal was different from those of the other sixteen inventors in that he did not intend to reap the crop. It was similar to Ridley's in that it was intended to deal with the mature crop, but differed from it, in that it beat out or thrashed the grain direct from the ears of the standing crop, thus eliminating the reaping operation contemplated by Ridley.

The feature of the "comb and beaters" introduced for the first time by Bull was definitely new and because of this it is doubtful whether Bull's idea, as illustrated by his model, was taken seriously. Apparently the long spearlike fingers of the comb appeared almost grotesque to those seeing such a design for the first time. Judging by a facetious letter which appeared in the "Register" of the 30th September, 1843, and could have referred only to Bull's model—over the pen-name of "A Very Pretty Model"—at least one person considered Bull's idea a joke (23).

III.—FAILURE OF JOHN RIDLEY'S REAPING MACHINE, OCT., 1843; SUCCESS OF HIS STRIPPER, EMBODYING THE "COMB AND BEATERS," NOV., 1843.

After the exhibition was over, Ridley evidently continued with the construction of his machine, which he had described, and to see which he had issued an invitation to those at the meeting on Wednesday, 20th September, 1843 (21). At least two other exhibitors, Swingler and Marshall, continued with the construction of the full-sized machines of which they had prepared plans. Bull, however, was not able, for financial reasons, to do this, but he made his model and idea available to any who cared to adopt them. As previously stated, Swingler's machine apparently did not prove successful, judging from reports in the "Observer" of 4th and 18th November (17), neither did Marshall's (31), nor as far as could be ascertained did any of the others. Because of Ridley's standing in the community and his reputation as a man of affairs, great things were expected of him and great interest was taken in his machine.

The "Register" of the 9th September (24), and the "Southern Australian" of the 26th September (26) commented extremely favourably upon it, and regarded it as almost certain to be successful. The "Register" considered that it would be

expensive—that this might interfere with its success. An anonymous correspondent however, considered that Ridley's calculations were unsound, that his expectations were, in consequence, not likely to be realised. His letter under the pen-name of "Q. in Corner" appeared in the "Observer" of 16th September, 1843 (26).

Ridley's machine was evidently completed some time in October, for in the "Observer" of the 28th of that month its trial and failure were announced (27), but four days later the "Register" (28), in an ambiguous article, implied that this report was incorrect, and went so far as to state "the report that his plan had failed is as malicious as it is false." The "Observer" in its next issue (29) confirmed its previous report of the failure and dispelled any idea that its attitude was malicious for it concluded "We shall be happy to hear of his (Ridley's) improved machine and no-one will be more ready than ourselves to herald its success." The "Southern Australian" of 7th November (30) supported the statement of the "Observer" (27) that there had been a failure, and that of the "Register" (28) that it was due to the use of wooden spikes or gatherers instead of iron ones.

The account in the "Southern Australian" (30) and those in the "Observer" (27 and 29) leave no doubt in the mind of the present writer that the trial of Ridley's machine prior to the 28th October was not successful. From reports in the "Observer" of the 4th (31) and 11th November (32) it is evident that even early wheat crops must have been immature in October and therefore in such a condition that the machine which succeeded in the middle of November, or even the modern stripper, would have failed in the manner described in the "Observer" (27 and 29). But the reference in the "Register" (28) causes considerable doubt as to the type of machine which was first tried by Ridley. It is stated (28) "as an improvement upon Mr. Ridley's first conception an attempt was made to construct the gatherers of wood, instead of iron, but this he has been compelled to abandon, from the shrinkage or warping of the wood, and has had to return to the iron. In no respect, therefore, has Mr. Ridley departed from his original projection." In view of the type of machine which succeeded on the 14th November, such a statement would imply that the machine in course of construction on 1st November, with the wooden gatherers used in the October trial replaced by iron ones was practically identical with Ridley's original projection or design. This is difficult to realise for the successful machine tried on November 14th was not a cutting machine, whereas Ridley's original projection as stated by himself (21) was a cutting machine, and, as reported in the "Observer" of 23rd September (20) and the "Southern Australian" 26th September (25) it was in course of construction. Such a machine, however, was designed to reap or detach the ears from the crop and then thrash them. The machine which succeeded thrashed the ears directly from the standing crop. It could be inferred that Ridley after seeing Bull's model at the historic September meeting (18) had the foresight to see its advantages and immediately decided to adopt it. This is supported by portion of a later letter to Bull by Allen, the proprietor-editor of the "Register" (46), which stated —"he (Ridley) had availed himself of all the best points of the model exhibited for the construction of his machine of those in yours amongst the rest." Such an inference however, conflicts with that portion of Marshall's letter (44) which states that Ridley "so far approved of the plan I showed as to offer to go half the expense of getting it up on condition that he might have the benefits which might be derived from it."

It is difficult for the present writer to believe that warping of wooden gatherers could be responsible for the failure as described. To the present writer it appears most likely that the machine used at the first trial was built on the lines of the Gallic machine with "its projecting row of prongs with cutters which may be made to collect and detach the ears of grain," as outlined by "Wheat

Grower'' (21). A trial would soon demonstrate that such a device could never detach the heads which were to be subsequently thrashed from either the immature or ripe crop.* After this had been demonstrated in October (27) Ridley determined to modify (29) (or improve) that machine by substituting the comb with its long fingers for the short sharp cutting teeth and shifting the thrashing device forward until it was almost over the rear ends of the fingers. Such alterations would produce the machine which was subsequently tried on 14th November (33-38).

Ridley, to his infinite credit, was persistent, and, as pointed out in the "Register" (28) did not suffer any abatement in his confidence of success, nor falter in his plan of gathering in the wheat harvest by mechanical means.

A further trial was made on Tuesday, 14th November, 1843. It was an undoubted success. Here was definitely a new method—so different from previous methods and so simple that the Governor when he saw it, expressed his "surprise that a method so simple should have remained so long untried" (33).

The machine and its method were so new that the Press had neither a name to fit the machine nor a word to describe the actual work it did. To overcome the first difficulty they called the machine a ''locomotive thrasher'' or a ''harvest machine'' and to meet the second they explained that it was not a reaping machine, because it did not *cut* the crop; it beat out the grain from the heads of the standing crop and, therefore, it resembled a thrasher, but the thrashing drum was replaced by arms to which beaters were attached. In other words it stripped the grain from the heads in the standing crop, but the word ''strip,'' which adequately described this new and unique operation had not then been coined. The beaters and the comb, which directed the grain to them, were the new and essential features of this welcome machine.

By the persistency and application of John Ridley, the practical man of affairs, the joke of ''A Very Pretty Model'' was now shown to have been an inspiration—the inspiration of John Wrathall Bull, a humble farmer.

IV.—EARLY POPULAR MISCONCEPTION OF RIDLEY'S PART IN THE DISCOVERY OF THE ESSENTIAL PRINCIPLE OF THE STRIPPER AS DISTINCT FROM ITS PRACTICAL APPLICATION.

To the present-day agriculturists, familiar with the more improved modern stripper, it is obvious from the Press reports recorded in appendices (33-38) that the statements made about the new and necessarily crude machine were extravagant. This, however, was excusable under the circumstances, for with the successful trial of Ridley's machine the much hoped for, but almost impossible, had come to pass. The wheat crops were being successfully harvested by mechanical means. No longer would portion of the harvest be wasted through lack of labour to gather it in. No longer would the area to be planted be governed by calculations which necessarily had regard to the scanty supply of labour likely to be available when harvest time came. Instead the area to be sown would be limited only by the labour available to prepare the land and plant it. A new era of prosperity and expansion had dawned for the Colony, and—we were to know later—for the whole of Australia.

In the general jubilation which followed the successful introduction of the new machine, the three Adelaide papers vied with each other in praising the

* The row of short, sharpened teeth said to be used in the Gallic machine set to form a series of V's into which the stalks would collect for severance by the cutting edges is not vastly dissimilar to the knife of a modern mower or reaper. Though these latter are lighter and finer, the arrangement is largely the same. This knife is serviceable only when it is moving rapidly between the fingers and across the faces of the ledger plates. Any agriculturist who has had the misfortune to have the mower knife stop, so that the cutting device is rigid, as in the Gallic invention, knows that the stalks would not be cut but pulled and passed over by the machine.

enterprise and perseverance of its maker, Ridley. He was acclaimed the man of the hour, as the conqueror, who had overcome the many difficulties associated with the harvesting of the main crop by his invention of this wonderful machine. Praise of Ridley was fully justified, for he had rendered a very signal service to the Colony, but in some cases this praise overshot the mark.

Though there is no contemporary press record that Ridley claimed the honour of inventing the stripper, the "Observer" (37 and 38) named him as the inventor, but, from a copy in the Adelaide Archives of an official despatch from Governor Grey to the Home Office (39), and dated November 15th, 1843—and from the correspondence between the Home Office and Ridley's agent in London (40, 41 and 42), it will be seen that Ridley regarded himself as the inventor and took immediate steps to protect his patent. It was also evident that these views represented those of a considerable section of the community, for in March, 1845, Bull deemed it necessary to put forward his claim as originator of the "comb and beaters." On the 10th of that month he wrote a letter to the "Observer," which was published on the 15th (43), in which he modestly stated his case. He pointed out he had been the first to introduce its new and essential feature, viz., the "comb and beaters," when he exhibited his model at the meeting in September. At the same time he paid generous tribute to Ridley for making and introducing the machine in which were incorporated the "comb and beaters."

Many people, like His Excellency Governor Grey, genuinely believed that Ridley was the inventor as well as the maker. It was quite natural to assume this. Usually the maker and introducer of a new machine would be the inventor and at this time there was no apparent reason to believe that there was any departure from what usually occurs, especially as the circumstances seemed to justify this assumption. Very few would be likely to remember the part Bull, a little known farmer from Balhamah, had taken in the introduction of the new machine, whilst nearly everyone interested in the wheat crop would remember what the prominent practical man of affairs—Ridley—had done. It was well known, for instance, that as early as the beginning of September, 1843, Ridley had a machine under construction: that this new machine which had achieved so much had been made in his own workshop, under his own supervision, and had been introduced and worked by his own men. It was forgotten that the machine as originally suggested by Ridley (21) had been a reaping or cutting machine, whereas the new machine did not reap the crops but thrashed the grain from the standing crop by the "comb and beaters." Because these things were forgotten it appeared only reasonable to many to assert that Ridley who made the first machine of its kind was its inventor especially when that machine was also called "Ridley's." A later pattern was to become known at "May's," because it was made by a firm of that name. No one will, however, suggest that May invented the stripper. It is thus obvious that the maker is not necessarily the inventor. There is, of course, a difference between the case of May and that of Ridley, in that Ridley made the original stripper, whereas May followed on.

V.—CONTEMPORARY EVIDENCE SUPPORTING BULL'S CLAIM AS THE ORIGINATOR OF THE ESSENTIAL FEATURE OF THE STRIPPER, THE "COMB AND BEATERS."

The evidence of well informed contemporaries confirms Bulls' claim to be regarded as the originator as distinct from the first maker of the stripper.

The records show (18) that Bull introduced the feature in which the new machine differed from all others, that is, the "comb and beaters." No record has been found amongst the old files to suggest that Bull pirated this idea from

Ridley, if the latter had had it in mind and had proposed to incorporate it in the machine he intended to build. Supporting first-hand evidence is also supplied by letters received by Bull at a later date from Samuel Marshall (44), J. G. Coulls (45), James Allen (46), and W. S. Whitington (47).

Samuel Marshall, whose machine was unsuccessful, was an exhibitor at the September meeting. He was a mechanic, who, as his letter states, assisted in the construction of the first machine made in Ridley's workshop. In his opinion Bull was the first "to originate the idea of thrashing the corn as it stood in the field." J. G. Coulls was also a mechanic familiar with the September exhibition who did smith's work for Ridley and made the "comb and beaters" for a machine built by Marshall for Bull. He states "Mr. Bull should have the credit of the invention of a machine to thrash the standing crop and for having given it for the benefit of the Colony." James Allen was also one of the exhibitors in September, 1843; at the time he was also proprietor and editor of the South Australian "Register." From his references to Ridley in the editorial of 2nd September 1843 (5), it is evident that he was fully acquainted with the latter's plans and ideas. In the letter to Bull dated 23rd March 1882* (46), the following passage appears—"until now informed by you I never understood that anyone doubted that you had quite as much to do with the projection of the reaping machine, which has been of so much use to the colony, as Mr. Ridley." Allen also made the significant statement that he had "a distinct recollection of Ridley having stated to him 'more than once or twice' that 'he had availed himself of all the best points in the models exhibited (in September, 1843) for the construction of his machine, of those in yours amongst the rest.' "

The letter, dated 20th November, 1875, of Whitington, who was a farmer living near Bull states he saw Bull's model and later Ridley's machine in the field which he went to inspect "and at once saw that it was the adoption of your (Mr. Bull's) model." He also states that "to do Mr. Ridley justice I did not hear that he claimed to be the inventor."

There is thus no evidence in the records to show that Ridley was the "originator" or "first finder out" of the "comb and beaters." It is, therefore, wrong to assume that he was the inventor. On the other hand, the evidence furnished by the old records is conclusive that Bull introduced the previously unknown principle of the "comb and beaters." He is, therefore, the inventor.†

As stated on pages 237-8 of his "Early Experiences of Colonial Life in South Australia," he conceived the idea on Boxing Day (26th December), 1842. The circumstances under which it was conceived have been extracted from that work and are given in the appendix (48).

VI.—BULL'S CLAIM FOR RECOGNITION, 1845.

The mild letter of Bull which had appeared in the "Observer" of the 15th March (43) was responsible for a long and angry leader in the "Southern Australian" on 21st March, 1845 (49). In this the Editor evidently allowed his emotion to outstrip his logic otherwise he would not have confused, as he did, the first machine referred to by Ridley writing as a "Wheat Grower" (21) on

* Copy certified by Percival E. Hoare, who was an accountant and collector of old South Australian records. As he was a collector it is reasonable to assume that the original was in his possession and retained by him.

† According to the latest and greatest authority—the "New Oxford Dictionary"—the definition of an inventor is "one who devises or produces something new (as an instrument or an Art)"; "The originator of a previously unknown method or means of doing something; the first finder out." Thus, unless the maker is also the originator of the new method he is not also the inventor. If this were not so, then "Singer," or "Wheeler and Wilson," instead of Elias Howe, might claim to be the inventor of the modern sewing machine, but Elias Howe is recognised as its inventor because he was the "first finder out" of its essential feature, viz., the "lock stitch."

2nd September, with the one made by him and which on 18th November (33) was reported a success, but which was very different in principle from Ridley's first conception.

It is also quite apparent that, with his layman's lack of knowledge of the technicalities of harvesting and harvesting machinery, he has not been able to appreciate the difference between the usual operation of thrashing the grain from the plants, which have been reaped or cut from the crop, and stripping it by means of beaters from the standing crop. Had he been able to do this he would not have fallen into the error of saying that Ridley, by means of beaters, proposed to overcome the difficulty of taking off the ears after being seized by the teeth of his first machine, for Ridley's original idea (21) was to detach the ears as the result of reaping or cutting them by the sharp edges of prongs or teeth and then thrashing them with the scutchers of the thrashing drum.

It is true, as he states, that Bull was very interested in the utilisation of the wheat for fattening sheep, as reported in the "Southern Australian," 19th September (50), and, because of the encouragement this idea received at the time, he elaborated the idea in a letter to the same paper upon which the Editor of the "Southern Australian" commented on the 22nd September (51). Because of the encouragement which he received Bull dealt with the same subject at greater length in three articles which the "Observer" published under the caption of "Mr. Bull's New System of Rural Economy."

The Editor is also quite right in saying that Mr. Bull at that time did not lay claim to the invention of Mr. Ridley, but for the best of all reasons, viz., that Bull's claim was to an invention which was quite different from Mr. Ridley's; the latter, a reaping or cutting machine, was, as the Editor states, then almost completed (20). As already explained it is believed this reaping machine when completed was a failure (27).

Though he confuses the "short teeth wide set in a row" of the Gallic machine for reaping the crop with the long fingers of the stripper for gathering the crop, the conclusion arrived at is that Mr. Bull may have discovered the application of the beaters, but that Mr. Ridley is entitled to the honour of an independent discovery. The records support his grudging admission of Bull's claim, but despite a very careful search nothing can be found to endorse his conclusion that Ridley made an independent discovery. It is evident that this conclusion is based upon the following statement in the Editorial:—"On Tuesday, 19th September, two adaptations of the ancient mode of threshing were presented to the Reaping Committee. Among them was that of Mr. Emmett on behalf of Mr. King, of Gawler Town, who proposed to cut off the heads by revolving knives: the other was by Mr. Bull, who proposed revolving beaters—in fact the same principle as had been mentioned by Mr. Ridley in the "Register" on the 2nd September. At the time, however, Mr. Bull brought forward his plan Mr. Ridley's machine was nearly "constructed." In the first place it must be pointed out that the Editor is in error in stating that Ridley, in his letter of 1st September (21), had referred to the principle of the "comb and beaters." This idea was brought forward by Bull for the first time on 19th September. Secondly, the Editor has overlooked the fact that Ridley's machine, was under construction (20 and 25) when Bull introduced his principle of revolving beaters. This mistake destroys the soundness of the Editor's conclusion.

The editor ends on a high note—"Mr. Ridley is entitled to the highest merit for his unwearied diligence, skill, patience and enterprise in constructing and carrying into effectual operation one of the most important machines which has been used for the benefit of agriculture and mankind." Few, if any, will dispute this: even Bull said the same thing on more than one occasion. Those

who to-day dispute Ridley's title of inventor of the "stripper" are in accord with the very true and proper sentiments so well expressed. Bull, himself, in the letter which was the cause of the editorial, had expressed similar sentiments.

It would appear from the Editor's admission regarding Bull, his conclusion regarding Ridley and his appreciation of the latter, that he feels that Ridley is entitled to great credit for his practical work in connection with the introduction of the stripper and that, in consequence, he must be regarded as having at least equal rights with Bull to the title of inventor.

The admission of the Editor "we fully believe all that Mr. Bull has stated" brings him into line with the Editor of the "Observer" (53) who also accepts Bull's statements as correct, viz., that he first brought the "comb and beaters" to public notice in September, 1843.

VII.—RIDLEY'S SILENCE.

Bull's reply to the editorial in the "Southern Australian" was in the form of a second letter to the "Observer." This appeared on 5th April, 1845 (52). This letter was in effect a challenge to Ridley in which Bull states that he is prepared to submit the evidence necessary to support his claim as inventor of the stripper, provided Ridley will either acknowledge that the views expressed by the editor of the "Southern Australian," regarding the invention of the stripper, are Ridley's or that Ridley, in a public manner will endeavour to refute any of the statements made by Bull.

It is significant that Ridley did not see fit to accept this challenge at the time. If he were the inventor of the stripper surely this was the time to establish his claim, seeing that the incidents which occurred at the meeting in September, 1843, and the events subsequent to and up to the time of the successful trial were well-known to many who were then alive. Ridley's default on this occasion must be considered as supporting Bull's claim, rather than his own right to the title of inventor of the fundamental principle of the Australia stripper. In accordance with the procedure then in force associated with the granting of patents (40) it is believed that, if Bull's letter of the 15th March, 1845, had been put forward at the proper time as a technical objection to Ridley's caveat (39), Ridley would not have obtained a patent whilst on the other hand one would have been granted to Bull had he desired it.

In the same issue of the "Observer," in which Bull's challenge appeared, there was an editorial comment on the matter (53). In this the editor acknowledges his belief in the statements made by Bull, but suggests that the idea put forward by him might have occurred also to Ridley. The evidence, however, shows that it did not. The editor naively concludes his comment by suggesting that Ridley was probably convinced "that the only plan likely to succeed was the one he so successfully carried out," but neglects to say that this plan—"the comb and beaters"—was the essential feature of the model exhibited by Bull in September, 1843.

Ridley continued to make these new harvest machines (54), and this undoubtedly tended to encourage the assumption that Ridley was its inventor. In consequence, when Ridley was leaving the colony in 1853, the testimonials and addresses which were then presented to him as a recognition of the great services he had rendered to the young colony invariably contained a reference to his early association with the stripper and referred to him as the inventor. This popular belief was also reflected in a resolution of appreciation which was passed by the Legislative Council of South Australia in 1858 (55).

It is not surprising that Bull's claim to be known as the inventor of the fundamental principle of the stripper was not more generally recognised. He was not

making strippers for the public and there was little or no direct evidence of his connection with the strippers being made by Ridley. Even at the outset Bull did not make the best of his case when he exhibited the model for to some extent he confused the issue by introducing a new idea for feeding and fattening sheep on wheat (18). Though this confused the issue, it should be pointed out that at the time the matter was of such interest that the "Observer" published three long articles written by Bull and entitled "Mr. Bull's New System of Rural Economy."*

Further, few of those who remembered the exhibition of models or designs would associate the new successful working machine with any of them especially as the winning exhibit of Swingler and that of the runner-up of Murray, had come to nought. Probably no one but Bull, or his friends particularly interested in his model, would realise that any feature of the unusual model was embodied in the new and successful machine made by Ridley. It was not reasonable to imagine that a farmer would be more likely to invent an entirely new mechanical process than one, whose work brought him into constant association with machinery. This view is expressed by Thomas Margerey,† who was Ridley's business successor at Hindmarsh. In support of his belief that Ridley was the inventor of the stripper he wrote—"Who would be the most likely to be the inventor of the locomotive reaper, is it the man to whom the whole subject of machinery was new, or the man who always lived in an atmosphere of machinery and invention?"

VIII.—PRESS DISCUSSION OF BULL'S CLAIM REVIVED 1875 AND 1879.

The claim that Ridley was the inventor was revived through the Press at recurring intervals. On each occasion Bull while he was alive and well, or later one of the members of his family challenged such statements.

One the the first of these claims was raised by G., in a letter which appeared in the "Register" of 21st December, 1876 (56). This letter drew attention to the economic advantage of the stripper, the invention of which the writer ascribed to Ridley, and, in recognition of his service in this connection, suggested the endowment of a Ridley Scholarship at the University. Bull replied in the issue of 27th December (57) and, after indorsing G's. appreciation of Ridley's services, pointed out that he, Bull, not Ridley, was the inventor.

As the result of this correspondence two settlers named Herbert forwarded letters to succeeding issues of the paper. One was from C. F. Herbert an old colonist and farmer at Pork Wakefield, who wrote on 13th January, 1876 (58), and the other from Septimane Herbert, J.P., of Wissanger, Yankalilla, 10th February, 1876 (59). Both indorsed Bull's statement and suggested that a substantial sum be collected to make in some fitting way a recognition of the service rendered by Bull's invention to the prosperi'y of the colony.

This was followed by a letter from J. B. Hughes in the "Register" of 17th February, 1876 (60), which asserted his belief that Ridley was the inventor, and resented what he considered an attempt to deprive him of due recognition as such. He gives the date of the introduction of the stripper incorrectly as 1842, it was not introduced until 1843. Bull replied in his characteristic way to this (61), and in his letter refers to his own stripper made by Marshall which was worked by W. L. Beare. This statement is corroborated by a letter from W. L. Beare (62).

* "A New System of Rural Economy" (Adel. "Observer," 7th Oct., 1843, pp. 7 and 8). Mr. Bull's second letter on Rural Economy (Adel. "Observer," 14th Oct., 1843, pp. 7 and 8). Mr. Bull's third and concluding letter on Rural Economy (Adel. "Observer," 28th Oct., 1843, p. 3).

† "A Backward Glance," page 391.

In the issue of 29th February Septimane Herbert again wrote in reply to Hughes (63). He again questions Ridley's right to the title of inventor and asks—"Was it not Ridley's intention to have patented his machine had he not been threatened by a caveat " the obvious assumption being that he would have done so if he had been the inventor, for he had taken the initial steps to secure patent rights (39-42). It is significant that Mr. Septimane Herbert disclaimed any particular friendship for Bull—"I may here remark (he concludes) I have not spoken to Mr. Bull for years and I am not aware I ever spoke to him in reference to the machine or its inventor."

Arising out of this controversy Bull submitted a request to the Chamber of Manufactures that they nominate a sub-committee to act in conjunction with a similar body from the Agricultural Society for the purpose of investigating and settling the question as to whether Ridley or himself was the real inventor of the stripper. The Chamber of Manufactures, however, decided that this was a matter for the Agricultural Society, which took no action. This appeared in the "Register" of 4th May, 1876 (64).

The matter was revived by a leader on "Agricultural Education and Mr. Ridley," which appeared in the "Register" 22nd December, 1879 (65). In this attention was drawn to the great benefit which the introduction of the stripper had been to the country, and, as some recognition of Ridley as the inventor, the establishment of a "Ridley Chair of Agriculture," a "Ridley Scholarship" or a "Ridley School of Agriculture" at the University was recommended. A. Wilson forthwith wrote to the Editor and stated—"I was surprised (without wishing to detract from Mr. Ridley's merits) that the name of J. W. Bull was not mentioned." He then went on to point out that he and other farmers regarded Bull as the inventor and he suggested that Bull be presented "with a substantial testimonial in recognition of his valuable invention." This letter appeared in the "Register" of 24th December, 1879 (66).

It would appear that a few months after this, Bull submitted some documents supporting his cause to a committee for an independent inquiry. The committee consisted of three well-known and reputable Adelaide residents—Messrs. Thomas F. Monteith, Herbert Evans and John Harvey. Thomas F. Monteith was the Mayor of Glenelg, and a well-known sheep farmer; Herbert Evans was a partner in the firm of Mildred and Evans, at that time Land and Commission Agents in Adelaide and John Harvey, of Salisbury, was a Member of Parliament, and a well-known pastoralist and farmer. Their report is published in the "Register" of July, 1880 (67) and confirmed Bull's claim.

About this time Bull also submitted the same or similar documents to the Commissioner for Crown Lands (Hon. A. Catt), who in turn forwarded them on to the Royal Agricultural and Horticultural Society. In the "Register" of 31st July, 1880, there was a report to the effect that "the brief of Mr. J. W. Bull, in which he claimed he was the inventor of the stripper had been received from the Commissioner for Crown Lands, and the Society were prepared to appoint a Committee to consider the claim, but, as the brief was very voluminous, provided the Government would bear the expense of printing." (68.)

It was not clear whether this brief was examined or not, but the ultimate result was that, in consequence of representations made to him, the Commissioner for Crown Lands (Hon. A. Catt) was responsible, on 5th September, 1882, for a grant of £250 being made by Parliament to J. W. Bull for services in improving agricultural machinery. It will be noted from the Hansard report (69) dealing with this matter than the Hon. A. Catt stated that "though Mr. Ridley was the inventor of the stripper, Mr. Bull had done a great deal towards perfecting it." This illustrates how incorrect was the popular view for the records already cited

show that the converse was the case. Bull's claim to recognition rests upon the fact that he had exhibited a model with the "comb and beaters" some two months before the first stripper was made. The present writer is unaware of any evidence to show that Bull contributed to the improvements subsequently made upon the original machine.

IX.—FURTHER CONTROVERSY, 1886.

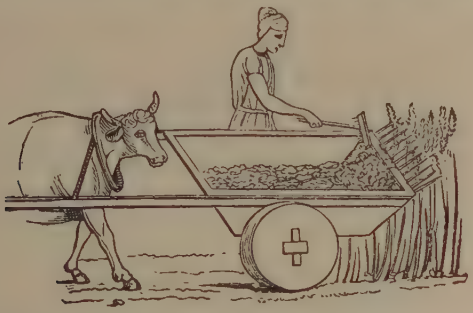
The controversy was again revived in 1886, and Ridley was brought into it for the first time. On the 18th January, 1886, Bull wrote a letter to the "Register" commenting upon an article which had appeared in an evening paper —the "Journal" on 15th January (70). This article was in the form of a letter from their London correspondent giving an account of a lecture at St. Leonard's, Sussex, by Mr. Anthony Foster, in the previous November. In this letter Bull pointed out that Foster in his lecture stated "for his reaping machine Mr. Ridley could take out no patent." In connection with this Bull stated "without fear of contradiction that Ridley applied to Governor Grey for a caveat to enable him to obtain a patent in England, and that, as reported, he withdrew the application."

It is true that Ridley took the first steps to obtain patent rights for this machine by applying for a caveat to protect his interests. This caveat was despatched by Governor Grey on November 15th, 1843—the day after the successful trial of the first stripper. The present writer has not been able to find a record of the reason why Ridley did not complete his plan for securing a patent. Bull in his letter (70) states that the press reports in September, 1843, describing the principle of his model, were a bar to this. There seems no reason but to believe that, had Bull legally presented the evidence contained in the "Observer" reports of September 23rd, 1843, (18), such action would have prevented Ridley's application for a patent being successful. On the other hand a letter in the South Australian Archives from Capt. C. H. Bagot to Ridley on 25th January, 1875, indicates that Ridley's desire was as altruistic as Bull's, and that the useful principle of the stripper should be available for all to use. The relevant extract reads—"Well do I remember your reply to me when I suggested your taking out a patent for your invention. 'No,' you said, 'I know it will be of incalculable value to the farmers of the colony . . . and I will not put any restriction upon my invention. I will leave it free to all to construct and to use it.'"

The account of the lecture was followed by a leader in the "Register" of 25th January, 1886, which was generally eulogistic of Ridley, but which pointed out there were claims other than those of Ridley which required consideration (71). This provoked a reply from Ridley, who was then living in England. He wrote on 18th March, and, after the necessary delay due to the distance between England and Australia, it was published in the "Register" of 6th May, 1886 (72). This was his first and last entrance into the controversy; it is to be regretted that he made it. At the time he was a sick man and 80 years old. He starts off with a wrong premise for he says—"For 30 years there was no question to my right to the sole honour of the invention, not till the year 1879 was anything heard of the pretentions to which you have again given currency." He must have forgotten that his alleged right was questioned by Bull within fifteen months of the trial of the first successful machine on 15th March, 1845 (43), and challenged on 5th April, 1845 (52) of the same year. Ridley had also forgotten the controversy which occurred in 1875, which commenced as the result of the publication of a letter by G. (56), and in which Bull (57), C.F. (58), and Septimane Herbert (59) took part. He concludes the advocacy of his claim by

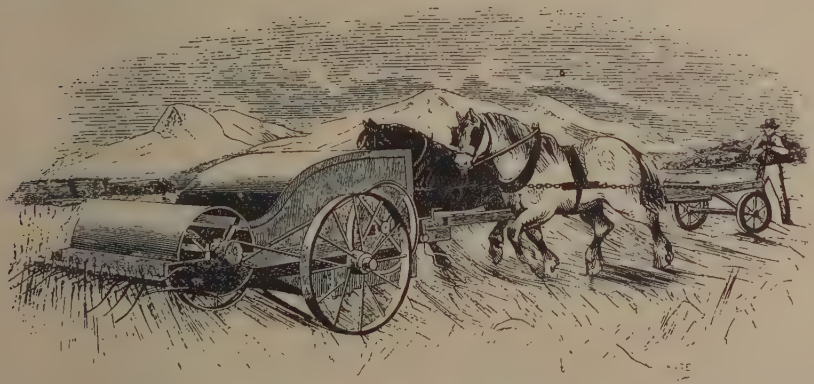
saying, "I have always said that the first suggestion of my machine came to me from a notice of a Roman invention given in Loudon's Encyclopaedia of Agriculture. To this I now add the statement that from no other source did I receive the least help or suggestion." Such a statement does not agree with those of Marshall (44) and Allen (46), nor with the early records.

It is true that Ridley's original conception did resemble the Roman invention referred to in that the reaping device consisted of a small set of teeth or prongs with sharpened edges and was pushed from behind, and, in addition, Ridley proposed to include a thrashing and winnowing machine. But the aged



The Gallic Reaping Machine as imagined by the artist from Pliny's description of it.
(From Loudon's Encyclopaedia of Agriculture.) (18)

maker had apparently forgotten that the successful machine, which did succeed, resembled the "Roman invention" only in that it was pushed from behind, and there the resemblance ceased. On the contrary the successful machine was not intended to cut or reap, and, in consequence, the projections were not sharp and, instead of being short, were long in order the more readily to gather the ears for the beaters to thrash.



THE ORIGINAL MACHINE.
(From "South Australia and its Mines," by F. Dutton.)

Following on the publication of Ridley's letter in the "Register," the editor on the 8th May retracted from the attitude taken up in January, when it was stated "others had a share in the commendation associated with the invention of the

stripper." This new attitude was based on the acceptance of Ridley's argument that for thirty years or thereabouts his title to be the inventor was absolutely undisputed. Not only is this statement incorrect but the reverse is the case. Ridley had been silent for 40 years; as early as 1845 he was given the opportunity but did not accept Bull's public request to "avow that he (Ridley) was the inventor."

After publishing a letter from Hiram Mildred on 8th May (73), the editor on 12th May reaffirmed his new attitude (74) and closed the matter by stating "we cannot undertake to publish any more letters on the subject." This prohibition presumably was meant to apply only to Bull and his supporters for six days later he published a letter from Jas. Kelly supporting the editorial view (75). He was, however, fair enough to give Bull the opportunity to reply on 19th May (76). Another letter from Hiram Mildred appeared in the issue of 20th May 1886 (77). Though Bull was a very sick man he replied on 26th May (78). In the same issue James Umpherston, another supporter of Ridley, with a very long letter, entered the lists to break a lance for his friend (79). To this Bull replied on 4th June (80). This is believed to be the last letter he wrote on the subject for he was then almost paralysed and in what was practically his death bed. He died at the age of 83 on the 21st September of that year.

Umpherston's letter was also responsible for a rather bitter reply from Bull's son—John Bowyer Bull—which was published in the "Register" of 19th June (81). In it he breaks new ground by giving the names of those who were responsible for various improvements to the original stripper and now incorporated in the modern one. An interesting feature of this letter is a graphic account of the events which led up to the invention of the stripper by his father in December, 1842, and of the trial of the first crude model during the succeeding winter. He also refers to a slight accident to himself which fixed the incident of the making of his father's model indelibly on his memory. The son also complained that Ridley and his friends had not contradicted his father's letters years ago but had waited until the eye-witnesses were dead.

As this letter by the son was written from Wallup, Victoria, whilst the father was at College Park, Adelaide, it could not have been written in collaboration. It, therefore, provides confirmatory first-hand evidence from personal knowledge of the father's statements on these points, which relate to the conception of the idea, and which led up to the "comb and beater" principle.

The complaint of John Bowyer Bull regarding the delay in the presentation of Ridley's claim caused Francis Duffield to write to the "Register" on 21st June (82) stating that he had been present at the historic September meetings, and that he could quite positively state that J. W. Bull exhibited "a model machine with a gathering comb and beaters, and that it was the only one of its kind exhibited." He added that since then he had been "fully convinced that Mr. Bull was the original inventor."

X.—MISS ANNIE RIDLEY'S ARGUMENT IN "A BACKWARD GLANCE," 1904.

The next important phase in this controversy was the publication in 1904 of "A Backward Glance, The Story of John Ridley, a Pioneer," by his daughter Annie E. Ridley. The object of her book was to show that but for John Ridley "the story of South Australia would have been, at the least, different, since the early prosperity of the country is largely ascribed to the invention of the 'Ridley reaping machine' made at the right moment and given freely without patent right." As to the general opinion regarding the great service rendered by John Ridley to South Australia few, if any, will disagree with Miss Ridley. However, the original records do not support Miss Ridley's inference that John

Ridley was the sole claimant to the honour for the introduction of the machine, which she calls the "Ridley Reaping Machine," but which, as is shown in the succeeding paragraph, is really the "Australian Stripper." Obviously Miss Ridley was not familiar with the difference in principle between the reaping machine and the stripper.

As carefully explained in every paper published at the time the new machine which was successfully introduced was not a reaping machine, because it did not cut the crop. In the absence of a suitable word to describe it it was first called a "locomotive thrasher" or "harvest machine," and the term "stripper" was not coined and adopted until later. It embodied an entirely new principle in that by means of the comb it gathered the ripe ears of wheat for the beaters, which then removed them and "stripped" the grain from them.

Miss Ridley's contention that her father was the inventor or originator of this new principle is based on incomplete knowledge of the circumstances leading to the practical introduction of the first "Australian stripper." These facts may be obtained from the early newspaper records which include the original letter from her father (21). Otherwise she would not have omitted any reference to the fact that the successful machine embodied the "comb and beaters" principle which was brought to the public notice for the first time by Bull when he exhibited his model with its "comb and beaters" at the meeting of the Corn Exchange Committee, and which was described and commented on in the "Observer" of 23rd September, 1843 (18). Instead she relies upon a reference to the new machine in "South Australia and Its Mines," by F. S. Dutton, which was published in 1846. It is obvious from the extract quoted that this author had accepted the popular opinion at the time and had not delved very deeply into the records of the subject.

Letters which describe the economic value of the machine are also given as evidence of Miss Ridley's contention that her father was the inventor of it. As has been shown, even though the first machines were made by Ridley, and therefore known as "Ridley's locomotive thrashers" or "Ridley's harvest machines," this line of argument does not by any means suggest or prove that Ridley was the inventor.

Another authority quoted by Miss Ridley—A. Forster—is equally hazy and more inaccurate on a very essential point. This gentleman gave a lecture on "South Australia" at St. Leonard's, Sussex, in November, 1885. When referring to the machine made by Ridley he is quoted as saying—"Its success was complete; *it cut the wheat and threshed it* and delivered it at the end of the furrow almost ready for market." One can only conclude that Mr. Forster was quite unfamiliar with the principle involved and the action of the stripper as it was at that time. Nor was he familiar with the history of its introduction, or he would have known that the first machine planned by Ridley (21) was to have cut and thrashed the crop. The subsequent successful machine did not cut the crop, it embodied Bull's principle of the "comb and beaters" (18).

XI.—A LATER CHAMPION OF RIDLEY: STEPHEN PARSONS—JOHN RIDLEY A PUBLIC BENEFACTOR.

In August, 1928, Ridley's claims were again asserted by Mr. Stephen Parsons, writing in the Adelaide "Register." These articles were reprinted and published as a pamphlet with the title "John Ridley, A Public Benefactor." The main purpose of Mr. Parsons was to show that Ridley had been a public benefactor. With this almost everyone will agree. Incidentally, however, Mr. Parsons sought to prove that Ridley was also the inventor of the Australian stripper. To support this case he quotes a letter from Mr. James Kelly, which appeared in the

"Register" of 18th May, 1886 (75), almost 43 years after the introduction of the first successful machine. Mr. Parsons accepts as proof of Ridley's claim to be the inventor of the stripper the fact that at one time during a visit to Kelly Bros.' farm, Ridley "showed James Kelly a rough sketch of a machine which he was making and which he said would be of immense assistance in harvesting the crops." Kelly further states that "he remembers on another occasion visiting Mr. Ridley at the mill and seeing the mechanics at work constructing the first reaper."

No one will question the accuracy of these statements, for they are in accord with the records of the time. Their only value, however, is to offer further support to the publications of the period which show that Ridley was interested in the construction of a machine to harvest the wheat crop by mechanical means, and that he was enthusiastic about the possibility of success. It by no means follows that the machine was successful because Ridley believed it would be; most prospective inventors believe their ideas are certain to be successful. It is quite possible, and in fact most probable, that the machine referred to was the one which failed.

Mr. Parsons is so convinced of the soundness of his own case that he does not even consider it necessary to refer to Bull's reply to Kelly's letter in the same paper on the 19th May, 1886 (76). Apparently, for the same reason he considers the statements on the same subject by men like Marshall (44) and Allen (46), who were exhibitors in 1843, as unworthy of notice, for he makes no reference to them.

In his reference to the circumstances at the time of the invention and the introduction of the machine Mr. Parsons quotes a document which purports to be the minutes of the September meetings, 1843. Though Mr. Parsons was justified in regarding it as an authentic document, it was not so. It is so obviously incomplete that some of the omissions should have been detected. It states that plans and models were exhibited by eight persons, whose names are given, but does not include either the name of Swingler, whose exhibit was adjudged the best, and to whom an award of £3 was made, or of Bull of whose presence at that meeting everyone interested in this matter must have been aware. As a fact though Ridley was absent there were eleven prospective inventors present at the first meeting on the 12th September, 1843.

Other evidence cited by Mr. Parsons on page 4 of his pamphlet is from the Adelaide "Observer" of 18th November, 1843 (33). "We have much pleasure in announcing that a further trial of Mr. Ridley's machine has established its success. His Excellency Governor Grey has inspected it and expressed approval of the mechanical principle developed." Mr. Parsons, however, makes no reference to the fact that the fundamental principle, which His Excellency approved, and which was responsible for its success, was that of the "comb and beaters" of John Wrathall Bull and introduced to public notice—including that of Ridley—at the meeting of the Corn Exchange Committee on Tuesday, 19th September, 1843. Apparently Mr. Parsons had not been informed of these facts. His ignorance of such material evidence, and the general insufficiency of the information used by him as evidence, render his conclusions concerning the rightful claimant to the honour of inventing the principle of the "Australian Stripper" entirely unacceptable.

XII.—CONCLUSIONS.

Throughout the controversy it will be noted that the supporters of Ridley pointed out that he was a worthy pioneer colonist, who had served the young colony well, that he had made and introduced the first stripper, that the stripper

had been of inestimable economic value to the community. All this was perfectly true and proved that Ridley rendered public service of such high order that its value could not be expressed in money terms.

With such statements the present writer is in entire agreement. They cannot, however, be allowed to obscure the point at issue in this paper, namely, whether Bull's contention was correct that he was the originator of the "comb and beaters," the unique and essential feature of the Australian Stripper. The records show that his contention was correct. As far as can be found no one did, or even attempted to, produce evidence to show that the records were incorrect. Even Ridley failed to respond, at a most opportune time, when in the "Observer" of 5th April, 1845 (52) Bull challenged him to assert that he, Ridley, had introduced the "comb and beaters." Nor did Ridley, or his agent, ever deny Bull's assertion that he was unable to complete the initial application which he lodged for patent rights relating to the stripper.

It is submitted that a careful reading of the newspaper records and of other documents referred to above establishes the following facts:—

1. In 1842 the shortage of manual labour for harvesting the expanding wheat crops in South Australia was so serious that agricultural development must have inevitably ceased, or at least have slowed down, unless mechanical means were discovered to do the work for which sufficient manual labour was not available.

2. Consequently, the Press and certain public men in South Australia began a movement to encourage persons with inventive and mechanical ability to devise and construct machines which would harvest crops efficiently with a minimum of manual labour. A committee was formed to examine and judge models which might be submitted, and a prize was offered for the model or machine adjudged by the committee to be the best and able to satisfy the requirements.

3. In September, 1843, sixteen competitors submitted to the committee models for inspection and adjudication. John Wrathall Bull was one of those competitors, but John Ridley was not a competitor. Although Ridley was not a competitor it was announced, on his behalf, that he was then in the course of devising and constructing a machine for harvesting crops.

4. Of the sixteen models or designs exhibited by the sixteen competitors in September, 1843, every model or design, except that of J. W. Bull, had incorporated therein as the fundamental principle of the machine some type of cutting device for reaping the crop.

   On the other hand J. W. Bull's model had incorporated therein as the fundamental of his machine the principle of the "comb and beaters" designed and intended not to cut or reap the crop but to gather the grain from the standing crop without cutting or reaping the stalk of the plant.

5. The principle of the comb and beaters designed and intended to gather the grain from the standing crop without cutting or reaping the stalk is the now long recognised fundamental of the "Australian stripper."

6. The committee, to which in September, 1843, the sixteen competitors submitted their models or designs, was apparently not satisfied that any of the models or designs exhibited satisfied the requirements in a machine to harvest crops, and apparently was not impressed with the principle of the comb and beaters incorporated in Bull's model, and therefore the committee did not award the prize offered to any competitor.

7. John Ridley was present when the committee examined the sixteen models, including Bull's, in September, 1843, saw Bull's model and heard Bull's explanation of the principle of the comb and beaters incorporated therein.

8. At the time of the exhibition of models and designs Ridley had not completed the machine which he was then constructing. Subsequently and during October, 1843, a machine constructed by Ridley was given a trial which proved the machine to be a failure.

9. Because that first machine was not successful when given a trial Ridley undertook its alteration to improve it or the construction of another machine. The improved, or the new machine was completed and given a trial in November, 1843. The trial proved successful, and that machine was the forerunner of the machine which subsequently was manufactured, and in course of time became known as the "Australian Stripper."

10. The machine used in the second trial did not have incorporated in it as its fundamental principle a cutting device as was the case with Ridley's machine under construction in September, 1843, but did have incorporated therein as its fundamental the principle of the "comb and beaters," that is the principle which was incorporated as the fundamental in the model which had been exhibited in September, 1843, by Bull to the committee, and which Ridley had had the opportunity to see and hear explained whilst he was in the course of constructing his machine, and which he invited the committee to inspect.

11. Bull obviously was the first to conceive and explain the principle of the comb and beaters as the fundamental of the "Australian Stripper" as distinct from a reaping or cutting machine.

12. Ridley was the first to embody the principle of the "comb and beaters" in a working machine, and to prove the effectiveness of that principle as the fundamental of the machine.

13. Ridley and his supporters cannot and should not claim that Ridley is entitled to credit for originating the principle of the "comb and beaters" as the fundamental of the "Australian Stripper," but they do owe and should give to Bull the credit of being the originator of that principle, the adoption of which by Ridley enabled him to be the first person to construct successfully the first effective stripper.

14. Bull and his supporters can claim that Bull is entitled to credit for originating the principle of the "comb and beaters" as the fundamental of the "Australian Stripper," and that Ridley is indebted to Bull for the latter's original conception of that principle.

    On the other hand Bull and his supporters cannot claim that Bull originated the first stripper because, although he originally conceived the fundamental principle, he did not establish its effectiveness in a practical working machine, which Ridley was the first to do.

If these facts be accepted—as indeed they must be by all who approach the question free from prejudice—it follows that Bull, by originating the principle of the "comb and beaters" and Ridley, by the application of that principle, rendered conspicuous service to South Australia and later to Australian agriculture. The two men are, therefore, entitled to share jointly in the honour which is fully merited by that service, the importance of which to Australian agriculture can hardly be exaggerated.

(1)

South Australian "Register," 26th August, 1843, *page* 2, *col.* 3.

The Approaching Harvest.

Gentlemen,—Believing you to be alike the friends of the agriculturist and of the agricultural labourer I beg your attention to what follows- the inadequacy of the present number of hands in the colony to get in the next harvest is now universally admitted. How, then, is the emergency to be met?

Some of the agriculturists in this district have rolled their land and intend to cut it down with the scythe, but others are thinking of the construction of a machine something after the fashion of Bell's reaping machine, of which there is a plate and a description in Loudon's "Encyclopaedia of Agriculture," pp. 422, 423, and to which you will perhaps call the attention of your readers.

For my part, I am anything but sanguine about cutting down wheat with the scythe, although I have rolled my land with the intention of making the experiment, and I have hardly any better hopes of succeeding with any machine, but, as there is a good deal of unemployed mechanical skill and ingenuity in the colony, it might not be amiss to call attention to this subject.

Any man who should construct a machine which would answer this purpose, and which would admit of being brought into general use, would be a benefactor to the colony, and would do more towards making it a successful corn growing country than anything that has hitherto been done for it by means of the plough.

Hoping to see you able to find room for this in your widely circulated journal.—I remain, Yours, etc.,

Morphett Vale, 22nd August, 1843. AGRICOLA.

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(2)

"A Backward Glance"—Annie E. Ridley, page 93.

An Extract from Report of Sir George Grey, Governor of South Australia during 1842-43, as recorded in Mr. Milne's "Romance of a Pro-Consul."

"It was the first extensive wheat crop of South Australia; the first harvest home of the bunch of people who had been shaken on to the sea-shore. When the wheat had ripened, everybody—including, I am glad to say, the Governor—turned to the harvesting of it. . . . . I had had 150 soldiers sent from New South Wales. That was a step on which I was entitled to congratulate myself. At the pruning hook, in getting in that harvest, they were of vast assistance, and not often have soldiers been more nobly occupied."

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(3)

"Adelaide Observer," 2nd September, 1843, *page* 4, *col.* 3.

Progress of Invention in South Australia.

The field of "Ceres" is destined to be won and the severe and more critical toils of husbandry rendered capable of amelioration by the help of mechanism, and here as in the projected aerial carriages (aeroplanes ? G.L.S.) a striking coincidence of thought is manifest since the idea of reaping by machinery has been simultaneously entertained and practicably acted upon by several of our colonists. From one correspondent we have received the following letter: (The letter describes a proposed machine for cutting grass for hay). . . . . Another informs us that his suggested improvement resulted from a casual inspection of some woodcuts representing the agricultural and husbandry implements of the ancient Goths, and the contrivances resorted to by that predatory nation for the rapid in-gathering of the harvest of their prostrate foes. All that we are at liberty to state at present is that the machine with a single horse and one workman will be competent to the reaping of four acres per diem. Two of the machines are in a forward state and will be ready to start long before harvest time. Of the third we can speak more definitely and in unqualified terms of approbation, although the author's* modesty will not allow us at once to give his name to the public. We hope, however, he will do himself that justice in our

* A letter was written by Samuel Marshall in a subsequent issue (9th September, 1843), and in this he gave details of his design and admitted that he was the author referred to. As subsequent records show that Marshall's machine was not successful when tried it is not considered necessary to include Marshall's description.

next. His machine, of which we have a correct drawing before us, is like the former one to be drawn by one horse, but it is calculated to cut *fifteen acres* a day, and by a clever contrivance the corn will be taken as cut and carried to a bucket or receiver till enough is collected for a sheaf, when it will be dropped on the ground ready for binding.

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(4)

"Southern Australian," 5th September, 1843, *page* 2, *col.* 1.

Labour-saving Machinery.

It is the part of wise men to provide for the worst. There is a possibility that, ere the harvest season arrives, the colony may be provided with an accession of labour; but as this is a contingency, we are glad that our farmers and others are endeavouring, in various ways, to limit the amount of manual labour required in getting in the ensuing crop. Among the various machines which have been proposed, we have the greatest gratification to announce that one has been discovered by an enterprising, ingenious and practical colonist, which, there is every reason to think, will save labour and expense in reaping and thrashing corn in an incalculable degree. The following are the particulars of the scheme which have been published by the "Register" in the form of a letter:

> "After what has been accomplished by mechanical science we need not fear over-rating its powers in asking assistance in reaping our grain crops, without which they are in danger of being of questionable value—reaping and threshing threatening to absorb the whole proceeds. As it is not upon the grain itself the labour is expended, but upon the straw, could we have a machine to collect the heads and leave the straw standing, thrashing and winnowing the grain at the same time, it is evident a large proportion of the labour at present employed would be saved; animal power cannot be employed more advantageously than in moving in a line; the speed for thrashing can be attained most easily in this way, and a projecting row of prongs with cutters may be made to collect and detach the heads of grain. By taking a breadth of five feet, two acres may be gone over in one hour, at the rate of travelling of three miles per hour, and instead of £2 per acre, two shillings will place the grain in bags.
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> "We may add that the inventor intends immediately to have a machine* made on the above principle, and, if it succeeds, it will doubtless be extensively used in the colony, as straw is at present of comparatively little value."

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(5)

"South Australian Register," 2nd September, 1843, *page* 2, *col.* 4.

Reaping, Thrashing and Winnowing by Machinery.

A highly respectable and intelligent correspondent has furnished us with a letter which appears in another column on the proposed construction of a machine for reaping, thrashing and winnowing at the same moment.

Of the practicability of constructing such a machine and that too at no great expense, we have no doubt whatever upon our own minds and we thus call public attention to it and especially in prospect of the approaching harvest under the hope that some of our ingenious machinists will turn their thoughts and talents for a little into this channel.

What had struck us, as likely to be of great advantage, was the construction of a machine similar to that used by the ancient Romans and of which a description will be found on page 26 of Loudon's "Encyclopaedia of Agriculture" merely for gathering in the ears of the corn, or something after the fashion of Bell's reaping machine† at page 422 of the same volume, but our correspondent,‡ who is a thoroughly practical as well as an intelligent man, repudiates the latter as but a small abridgment of labour and expense, and looks upon the former as but one step in the progress

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* This refers to Ridley's machine, vide appendix 49.

† The Editor of the "Register"—James Allen—exhibited a model based on Bell's reaping machine at the subsequent meeting of the Corn Exchange Committee on Tuesday, 12th September, 1843.

‡ The correspondent was John Ridley writing under the pen name of "Wheat Grower."

of improvement which it would require but a small amount of mechanical ingenuity and skill to carry to perfection.

We have not now to wait "four months" and then "cometh harvest," the probability being that in two months from this date, or in ten weeks at farthest, reaping will be general on the plains of Adelaide and that too with a lamentable deficiency of hands. Anyone, therefore, desirous of taking up the idea thus thrown out should lose no time in experimentalising upon it, but should be prepared to say whether such a machine could be constructed with the certainty of its answering, and if so, at what expense.

Whatever may be the nature of the machine, it must be simple in itself, easy of construction, and not likely soon to be put out of repair, so that it may answer for the crops of a whole neighbourhood, and be constructed at the joint expense of the neighbourhood or it will be but of little use. Our readers, we hope, will do our correspondent the justice of carefully perusing his letter and should no other party attempt the construction of a model of this kind, we can, we think, get one constructed ourselves at a small expense and which as soon as completed shall lie for inspection at this office.

Of course the latter suggestion is intended to apply to a contrivance for gathering in the crop merely, and not to our friend's improved method of thrashing and winnowing the grain at the same time.

The expense of constructing a machine for the latter purpose is the only obstacle we see to its being brought into general use.

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(6)

"Adelaide Observer," 9*th September,* 1843 (*Saturday*), *page* 4, *col.* 3.

Reaping Machines.

"In calling attention to the meeting advertised for Tuesday next, in reference to these colonial inventions, we may just state that since our last publication several gentlemen have favoured us with a sight of finished designs, outline sketches or descriptive particulars of their reaping machines, and amongst whom we may mention the names of Mr. Murray (late of the Port), Mr. Ridley and Mr. Thornber. It would be invidious in us to say who has evinced the greatest originality of thought, combined with cheapness and practical utility. That we may safely leave with the adjudicators."

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(7)

"Register," 9*th September,* 1843, *page* 1, *col.* 2.

Reaping Machines.

"All parties having plans or models of the above are invited to meet the Corn Exchange Committee at Payne's Hotel on Tuesday evening next at seven o'clock when it is proposed to grant facilities for the making of the most approved design, due regard being had to the interests of the inventors."

(Signed) R. THORNBER, Secretary.

September, 1843.

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(8)

"Southern Australian," 15*th September,* 1843, *page* 2, *col.* 3.

"After a little consultation the Chairman (Alderman Peacock) announced that the Committee would guarantee £10 as a premium for the best machine."

A later reference in the same issue stated—

"We are informed that the Agricultural Society intend immediately to set on foot a subscription for the purpose of raising £30 or more as a premium for the best reaping machine. This prize will be independent of that 'awarded by the Market Committee'."

(9)

"Adelaide Observer," 16*th September*, 1843, *page* 4, *col.* 1.

"A suggestion was made that the names of the known inventors should be read, when the worthy Alderman (*i.e.* the Chairman, Alderman Peacock) again rose and read the names of Messrs. Allen, Marshall, Robertson, H. W. Phillips, Coutts (? Coulls), Thornber, Murray, Ridley, Owen Smith, Hall, King and Francis."

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(10)

"Adelaide Observer," 16*th September*, 1843, *page* 4, *col.* 1.

"Mr. Ridley was next called for, but not being present, a friend volunteered on Mr. Ridley's behalf to explain it (Mr. Ridley's machine) was intended to comprise the subsequent process of threshing as well as reaping."

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(11)

"Southern Australian," 15*th September*, 1843, *page* 2, *col.* 3.

"Mr. Auld's machine was to have knives the shape of one large V the whole width of the vehicle. The corn was to pass through the carriage and be left behind in a scattered state."

(It is considered this name Auld is a misprint for Hall (G.L.S.))

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(12)

"Observer," 23*rd September*, 1843, *page* 1, *col.* 3.

Reaping Machines.

"At a meeting of the Corn Exchange Committee held at Payne's Hotel on Tuesday, Wednesday and Thursday evenings to determine upon the award to the inventor of the best reaping machine, models or drawings were exhibited by the following persons, viz.:—Messrs. Chas. Phillips, T. Y. Cotter, A. J. Murray, E. Emmett (for John King), S. Marshall, Jas. Pitcher, J. U. Bull, Francis, Herbert, B. Swingler, Hall, O. Smith and Robertson, when it was moved by Mr. Jas. Allen and seconded by Mr. J. B. Neales,—First, that in adopting a machine to which the prize should be awarded, pursuant to public announcement, regard be especially had to such a one as is easy of construction and consequently capable of adaptation to the in-gathering of the forthcoming harvest. Moved by Mr. Stocks and seconded by Mr. H. W. Phillips, Secondly, that this meeting having carefully examined the models and plans submitted to it, is of the opinion that no machine has been exhibited which the Committee feel justified in recommending for general adoption, but the plan of Mr. Swingler presenting some ideas which the Committee is desirous of seeing developed in a working model, have awarded him the sum of £3 to place one at their disposal."

(Sgd.) WM. PEACOCK, Chairman.

21st September, 1843.

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(13)

"Southern Australian," 26*th September*, 1843, *page* 2, *col.* 2.

Reaping Machines.

"The Market Committee during the last week held three meetings, viz. Tuesday, Wednesday and Thursday, when models or drawings of reaping machines were exhibited by or on behalf of the following inventors:—Messrs. C. Phillips, T. Y. Cotter, A. J. Murray, John King, Samuel Marshall, J. Pitcher, J. W. Bull, Francis, Herbert, Swingler, Hall, Smith and Robertson. The Committee stated that no machine had been exhibited which they could recommend for adoption, but awarded £3 to Mr. Swingler to enable him to make a model."

(14)

"Register," 23rd September, 1843, *page* 3, *col.* 2.

Mr. Swingler's Reaping Machine.

Gentlemen,—Annexed is a description of my model of a reaping machine exhibited at Payne's Auction Mart Tavern furnished at your request. The model consists of a series of inclined plates, resembling plough moulds, placed at a distance from the cutting knives and following each other. Each takes a step or line in the corn of about 15 inches in breadth, their number depending upon the size of the machine and the power employed. However large the machine it will admit of cutting at pleasure any quantity, proportionate to the power employed, by leaving so many steps out of the line taken. These plates enter the corn with a vertical edge and are so inclined as to compress the corn to a breadth of about eight inches, and give it an inclination over a movable platform constructed by a broad endless band passing over small rollers which, when it is cut, carry it by a gentle but sure method to one continuous line outside the machine.

The cutting is performed by a series of knives similar in shape to a sickle revolving on an axis between two plates and so made as to give themselves an edge or by a fine circular steel disc toothed like a sickle with its outer edge a little protruding through a slit in the mould or plate. This knife may be kept sharp by a small steel roller similar to a milling tool only that the cutting teeth are very hard and sharp. It will not be necessary to allow this disc to be continually sharpening itself, but it may be done at regular intervals by the machinery. A small wheel goes near the fore part just behind and in the line cleared by the first mould. Two wheels are behind the machine, and in the rear, the horse is placed in shafts which revolve in a circular frame in an eccentric manner so that the relative position of the horse may be altered for turning the machine, or if more convenient the horse and wheels may be placed in the centre and the traversing wheel behind which would give such a power or leverage over the horse as to render all obstinacy in the animal (as to direction) unavailing. I had some idea of constructing a machine to bind the corn, but I find the complication and expense, together with the power expended in so doing to be decided objections.—I am, Gentlemen,

R. SWINGLER.

Islington, September 21, 1843.

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(15)

"Register," 7th October, 1843, *page* 1, *col.* 2.

Reaping Machines.

At a meeting of the Corn Exchange Committee and others held at Payne's Hotel on the evening of Thursday, October 5th, for the purpose of examining a model of a machine for cutting corn made by Mr. B. Swingler, it was resolved—

First, that a machine be made on the principle of his model and the expense of its construction be provided by public subscription.

Second, that the following gentlemen be constituted a Committee for obtaining subscriptions—D. Macfarlane, Esq.; W. Peacock, Esq.; J. B. Neales, Esq.

Third, that Messrs. Stocks, Phillips and Ridley superintend its construction.

The amount subscribed at the meeting of the Committee was:—D. Macfarlane, Esq., £2; W. Hughes, Esq., £2; H. W. Phillips, Esq., £2; J. B. Neales, Esq., £2; Samuel Stocks, Esq., £2; W. Peacock, Esq., £2; James Allen, Esq., £1.

W. PEACOCK, Chairman.

Adelaide, 5th October, 1843.

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(16)

"Observer," 14th October, 1843, *page* 1, *col.* 3.

The Prize Reaping Machine.

"Messrs. Swingler and Harding of Islington beg to announce to the agriculturalists of the Province that they shall be happy to receive orders for their reaping machine according to the plan which the committee have pronounced 'the best.' Since the model was delivered to the Committee they have made improvements which

they believe places the success of their machine beyond doubt. The price of a machine on the cheapest plan to be effective is £30 and a very superior one will be £35. The difference of price will not affect the principle, but the style of workmanship and material."

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(17)

"Observer," 4th November, 1843, *page* 5, *col.* 3.

"We understand that early next week Messrs. Swingler and Harding's reaping machine will be ready for work."

"Observer," 18th November, 1843, *page* 5, *col.* 1.

". . . . . Mr. Murray's machine seems to lag behind and we begin to wonder what has become of Messrs. Swingler & Harding's chef d'oeuvre."

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(18)

"Adelaide Observer," 23rd September, 1843, *page* 6, *col.* 2.

"Mr. Bull, of Mount Barker, was now introduced. His machine consisted of a long-toothed comb, fixed to the back of a close-bodied cart; the teeth being operated upon by four revolving horizontal beaters, with square edges, which would have the effect of taking off the ears of corn and depositing them in the body of the cart, a wide bag being placed under the after part of the comb to catch any dropped grain. Mr. Bull explained not only the principles of his invention but their diversified beneficial application. 'I do not think,' said he, 'that we want or can afford to pay for a nice mode of in-gathering corn, and if my plans are followed out (which I shall be happy to communicate to any inquirer) the farmer of an estate of a hundred acres will find means to feed three hundred sheep and fifty pigs annually. The sheep will pick up every grain of waste corn, and green fodder as well as pigmeat may be produced with greater facility than people generally imagine. I have little faith,' continued Mr. Bull, 'in the expediency or profit of boiling down ordinary bush sheep for tallow, but, if sheep were fattened upon the leavings and refuse of our corn, they would turn to some account.' A sheep might be fattened at an expenditure of about three shillings worth of corn, and he had seen the most surprising effects produced upon a small flock by putting them into wheat stubble. Sheep in the worst condition would receive decided benefit and he had reason to believe that animal disease would be materially diminished by a change of feed, such as the judicious cultivator might easily arrange. Mr. Bull concluded his remarks by again adverting to the properties of his machine which, he said, could be constructed for £8. A small crop might be cut and gathered by applying similar implements to a small hand-cart, or even a wheel-barrow."

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(19)

"Observer," 16th September, 1843, *page* 4.

Description of Machines.

ALLEN.—His model consisted of a close-bodied cart with the shafts so that the horse should push it rather than draw it. The cart was made low and armed with a series of fixed and pointed knives having double-cutting edges, presenting the appearance of a close row of bayonets. Upon these (with the points considerably to the rear) were a similar movable row of knives which were also bayonet-like and so placed and adapted as to receive lateral motion from the revolution of the wheels. It was, in fact, an adaptation of Bell's reaping machine to the cart used by the Gauls.

ROBERTSON had no time to prepare plans or drawings.

H. W. PHILLIPS exhibited a small paper model which resembled Bell's Scotch reaping machine.

COUTTS had no design or model.

THORNBER had a model calculated to cut the corn, consisting of a long knife, intended to oscillate by the revolution of the wheels and to cut the corn horizontally.

MURRAY declined to produce a model or plans.

HALL proposed to harvest the crop with two cutting knives, each presenting the edge at an angle of about 40 degrees, joined in the centre, with two horses pushing the vehicle.

FRANCIS submitted a design with a reversed cart; the front was shaped something like a plough and along its extent was a narrow opening through which sickles were to protrude and operate as if guided by the human hand.

OWEN SMITH submitted a design which consisted of a gathering bar attached to a light carriage, the gathering bar was intersected transversely by a series of fixed under-cutting knives.

"Observer," 23*rd September*, 1843, *page* 6.

CHARLES PHILLIPS (H. W. Phillips ?). This exhibitor proposed to harvest the crop by means of a machine with a two-rowed sharp tooth comb cutting laterally and put in motion by the onward progress of the vehicle, and furnished with a lateral moving cloth for the removal of the corn.

Dr. COTTER suggested a machine comprised of four scythes mounted in a cradle.

A. J. MURRAY exhibited a drawing showing that the crop was to be cut by a straight knife with an action resembling that of a sabre.

KING exhibited a model machine consisting of a horizontal comb with protruding teeth for gathering, and four diagonal bent knives on a revolving cylinder for cutting off the corn upon the teeth.

SAMUEL MARSHALL exhibited a drawing. The cutting implement was circular and the corn when taken off was carried by the operation of rollers and an endless cloth and dropped into receivers called buckets, calculated to hold enough for a sheaf which was then dropped gently on to the ground.

PITCHER presented a drawing which provided for a vibrating cutting motion to cut a swath nine inches wide.

HERBERT had designed a strong-framed cart associated with four horizontally placed scythes.

ROBERTSON proposed an apparatus intended to be fixed on a vehicle consisting of an outline cylinder of considerable magnitude surmounting a sharpened discus of nine feet diameter, the whole revolving upon a vertical spindle.

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(20)

"Observer," 23*rd September*, 1843, *page* 6, *col.* 3.

"At the conclusion of the meeting Mr. Ridley stated 'that although he had purposely declined entering into competition with the other inventors his reaping and threshing machine would be ready for action on Monday next when he would be happy to show it to the Committee'."

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(21)

"Register," 2*nd September*, 1843, *page* 3, *col.* 2.

Reaping, Threshing and Winnowing Machine.

"Gentlemen,—After what has been accomplished by mechanical science we need not fear over-rating its powers in asking assistance in reaping our grain crops, without which they are in danger of being of questionable value—reaping and threshing threatening to absorb the whole proceeds As it is not upon the grain itself the labour is expended but upon the straw, could we have a machine to collect the heads and leave the straw standing, threshing and winnowing the grain at the same time, it is evident that a large proportion of the labour at present employed would be saved. Animal power cannot be employed more advantageously than in moving in a line. The speed for threshing can be attained most easily in this way and a projecting row of *prongs* with *cutters* may be made to collect and detach the heads of grain. By taking a breadth of five feet two acres may be gone over in one hour at the rate of travelling of three miles per hour, and instead of two pounds per acre two shillings will place the grain in bags.

I throw out these hints under the hope of attracting the attention of the readers of your widely circulated journal to them and I do not think the mechanical ingenuity of the Province could be better employed than in bringing something of this sort to the test of actual experiment."—Yours truly,

"A WHEAT GROWER."

[The italics are mine.—G.L.S.]

(22)

The Description given in Loudon's Encyclopaedia of Agriculture of the ancient Roman Machine referred to in the Editorial of the "Register" (5) and in that of the "Observer" (3). Pages 25 and 26, Sec. 33.

A reaping machine used in the plains of Gaul is mentioned both by Pliny and Palladius, which is thus described by the latter:—"In the plains of Gaul they use this quick way of reaping, and, without reapers, cut large fields with an ox in one day. For this purpose a machine is made carried upon two wheels, the square surface has boards erected at the side which, sloping outwards, make a wider space above; the board on the fore part is lower than the others, upon it there are a great many small teeth wide set in a row answering to the height of the ears of the corn and turned upwards at the ends. On the back part of this machine two short shafts are fixed like the poles of a litter; to these an ox is yoked with his head to the machine and the yoke and traces likewise turned the contrary way. He is well trained and does not go faster than he is driven. When this machine is pushed through the standing corn all the ears are comprehended by the teeth and heaped up in the hollow part of it, being cut off from the straw which is left behind, the driver setting it higher or lower as he finds it necessary, and thus by a few goings and returnings, the whole field is reaped. This machine does very well in plain and smooth fields and in places where there is no necessity for feeding with straw. (Pal. lib. VII., cit. 2.)

A conjectural delineation of this machine (fig. 16) is given by Lasteyrie in his "Collection des Machines."

On page 24, par. 123, the following appears:—"From his description" (Pliny's description of the above machine) "this machine must have borne a considerable resemblance to that used in Suffolk for cropping the heads off clover left for seed and not unlike modern attempts at an engine of this description."

An Extract from the English Translation of Pliny's "Natural History" by John Bostock, M.D., F.R.S., and H. T. Riley, M.A., 1856, Book XVIII., Chapter 72, Page 103, giving further details regarding the Gallic Harvest Machine described in Loudon's Encyclopaedia of Agriculture.

"The mode of getting in the harvest varies considerably. In the vast domains of the provinces of Gaul a large hollow frame*, armed with teeth and supported on two wheels, is driven through the standing corn, the beasts being yoked behind it; the result being, that the ears are torn off and fall within the frame."

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(23)

"Register," 30th September, 1843, *page* 3, *col.* 2.

"There was one" (model) "however, I thought if he would not do for reaping he would make a good fighting boy. I mean that one with such an enormously wide mouth and lots of great teeth like spears. There was a remark in your paper lately that the Governor objects to whalers coming into the port free, because foreigners would see our defenceless state and I suppose he thought if the Mother country should fall out with any of them that they might take advantage of it. Now gentlemen, if that should be the case it would only be necessary to get this boy made into a man, fix him to a carriage with a steam engine with a man or two to guide. Well shaded it would soon annihilate a host and there would be nothing more to do but go aboard their ships."

(Sgd.) "A VERY PRETTY MODEL."

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(24)

"Register," 9th September, 1843, *page* 2, *col.* 4.

Necessity the Mother of Invention.

The above adage is likely to meet with ample verification in the state of our labor market and in the means which are about to be employed for gathering in the present season's crop. No less than five or six different parties are engaged at this

* Palladius gives a long description of this contrivance, which seems to have been pushed forward by the ox; the teeth, which were sharp at the edge and fine at the point, catching the ears and tearing them off. But, as Fée says, the use of it must have been very disadvantageous, in consequence of the unequal height of the stalks. The straw, too, was sacrificed by the employment of it.

moment in the contrivance or construction of machines by which the present harvest is to be safely housed, if not indeed thrashed and winnowed as it is taken from the ground. Of these parties, Mr. Ridley of Hindmarsh deserves to be placed at the head of the list inasmuch as he proposes not only to reap by machinery but to thresh the corn out and winnow it at the same time. Of Mr. Ridley's plan we know enough to enable us to pronounce favourably upon it, the only obstacle to its practicability and universal application, as it appears to us, being its great expense.

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(25)

"Southern Australian," 26th September, 1843, *page* 2, *col.* 2.

Reaping Machines.

Mr. Ridley's machine if it answers his expectations will probably supersede all the others. Mr. Ridley has not put himself in competition with the others but has commenced to construct his machine. It will beat off the ears, thrash and winnow the corn at the same time, and if it succeeds will make a complete revolution in Agriculture. It is not true as stated by the "Observer" that the machine is ready for action. It may be so in a week or ten days.

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(26)

"Observer," 16th September, 1843, *page* 7, *col.* 2.

"The machine of Mr. Ridley which is intended to reap, thresh and winnow fifteen acres per day was not forthcoming, but as I know that with the strength of three horses and eight or nine men the threshing machines which have been at work here have not averaged 100 bushels per day and that the winnowing machines have not been able to clean even at that rate, I think it high improbable that fifteen acres or about 300 bushels per day will be wiped off in this masterly style by any machine."

(Sgd.) "Q IN CORNER."

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(27)

"Observer," 28th October, 1843, *page* 5, *col.* 2.

"A very complete thrashing machine has been lately constructed by Mr. Hutchinson of Bank Street whose abilities as a maker of Winnowing machines and other implements are so well known. In our next number we hope to report the success of at least one reaping machine. Mr. Ridley's has failed."

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(28)

"Register," 1st November, 1843, *page* 2, *col.* 5.

"Mr. Ridley's reaping and thrashing machine is now, we understand, all but complete, and will be ready for a fair trial in the course of two or three days. As an improvement upon Mr. Ridley's first conception, an attempt was made to construct the gatherers of wood instead of iron, but this he has been compelled to abandon, from the shrinking or warping of the wood and has had to return to the iron. In no respect, therefore, has Mr. Ridley departed from his original projection, nor has he at any time suffered any abatement in his confidence of success. The report that his plan had failed is as malicious as it is false."

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(29)

"Observer," 4th November, 1843, *page* 5, *col.* 2.

"We are surprised that Mr. Ridley or any one for him should attempt to deny the statement made in our last, namely that his machine had failed. If tearing up part of the corn by the roots and passing over the rest be not a failure we know not what is. We shall be happy to hear of the completion of his improved machine and no one will be more readily than ourselves to herald its success."

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(30)

"Southern Australian," 7th November, 1843, *page* 2, *col.* 5.

"Mr. Ridley's reaping and thrashing machine is all but completed. It has been partially tried and has answered admirably. The only failure was in the wooden spikes. Mr. Ridley is now making iron spikes."

(31)

"Observer," 4th November, 1843, *page* 5, *col.* 2.

"Mr. Marshall's reaping machine, although not quite complete, was put to the test last night. As far as we are able to learn it cut the corn admirably but failed in throwing it on the revolving cloth so as to enable him to drop it a sheaf at a time. He and others expected that the corn would fall against the edge that cut it but it took a contrary direction. It was satisfactorily proved, however, that the corn cut would have been left in a well-formed swathe had it not been prevented by the arrangements made for receiving it on the cloth. The trial was not considered a fair one by many who witnessed it, as the difference between grain and ripe corn is considerable, the weight being in the head in ripe corn and vice versa in green; so that it was thought that it would fully answer in corn that was ripe, as it would take a different direction when cut. It was late in the day when tried so that there was not an opportunity of trying it on ripe corn, but we understand it will be tried to-day on ripe barley, so that its efficiency will be fully tested. If Mr. Marshall should be obliged after all to abandon the gathering, still he has produced a reaping machine which will cut the grain as fast as a horse can travel and lay it in a regular swathe."

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(32)

"Observer," 11th November, 1843, *page* 5, *col.* 3.

"Mr. Everard has commenced his wheat harvest.* The urn is said to be remarkably fine, free from smut or other disparagement, and the crop quite equal to 40 bushels per acre."

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(33)

"Observer," 18th November, 1843, *page* 5, *col.* 1.

"We have much pleasure in announcing that a further trial of Mr. Ridley's machine has established its success. His Excellency the Governor has inspected it and expressed his approval of the mechanical principles developed and his surprise that a mode of application so simple should have remained so long untried. The machine will collect the ears, thresh them out, winnow the corn and fill the bags. The ingenuity of the invention and its great utility will be practically shown during the present harvest and not only convince the most sceptical but overcome the ill-will of those who are selfishly or ignorantly opposed to labour-saving machines, the invention of which in the United States of America has necessarily become an object of general study and in fact contributed to promote the extension of their territory and resources in an extraordinary degree. We have not styled this excellent invention a reaping machine because properly speaking it is not one, but rather a locomotive threshing machine with the additional powers previously described.

"We hope Mr. Ridley will succeed in obtaining such a patent right as may appropriately reward his talent and perseverance. At all events he has already earned the gratifying palm of merit and we trust he will long continue to wear it."

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(34)

"South Australian Register," 15th November, 1843, *page* 2, *col.* 3.

Mr. Ridley's Reaping and Threshing Machine.

"Mr. Ridley's reaping and threshing machine is now complete, and, on being tried yesterday, was found to answer admirably. The success, in fact, is most triumphant, and Mr. Ridley is entitled, not only to the thanks of the colonists of South Australia, but to those of the whole agricultural world. The two separate processes of reaping and threshing at the same moment are complete. On inspecting it a few days ago His Excellency the Governor expressed himself delighted with its simplicity, and, as is usual in such cases, was amazed at so simple a discovery not having been previously made. Mr. Ridley, we understand, has lodged a caveat with His Excellency with a view to the protection of the discovery."

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* The crop when harvested with sickle or scythe for subsequent use is usually reaped when immature.

(35)

"Southern Australian," 17*th November*, 1843, *page* 2, *col.* 4.

Complete Success of Mr. Ridley's Thrashing Machine.

"We have great pleasure in being able to make the above announcement, and having inspected the work done by the machine, we state with confidence that Mr. Ridley's invention must form altogether a new area (sic) in agriculture. The trial took place on Tuesday last on a farm near Bowden belonging to Mr. Ridley at present possessed by a person named Langman. The machine is not strictly speaking a 'reaping machine' as it does not cut the corn. It is simply a small thrashing machine pushed forward among the corn by two horses.

"It has a number of spikes in front to collect the ears, which, by the forward motion, are brought under the influence of the drum. The drum takes off the ears, or rather beats the grain out of them in the usual manner, and the process so far is completed; a person, of course, attends with bags to receive the grain and delivers them either into a dray or upon the field. It is calculated that with a fair crop a bag of three bushels will be filled every ten minutes and the machine will go over upwards of an acre per hour. It should be observed that the straw is left behind, so that the force of the machine is much greater than that of an ordinary thrashing machine where the large quantity of straw taken in along with the grain very much decreases its action and power. At the trial above recorded, though the wheat was green, the grain was nearly all thrashed out and we may add that a process recently discovered in England by which ears not thoroughly thrashed are thrown back again and again has been applied to the present machine. The complete collection of the ears is the most astonishing thing of all. Every ear, with the exception of a solitary one, so far as we saw that came within the scope of the collecting spikes were (sic) taken up or cleared of the grain and we are convinced that under proper management there need not be the loss of a bushel of wheat in twenty acres and that loss must arise where the corn stalks are only a few inches in height. From the great difficulty in getting workmen to make the iron spikes, the machine will not be complete for a few days and from the same cause there will be considerable delay in preparing (which Mr. Ridley intends) another; but there is no doubt that even this one will be an immense assistance during the ensuing harvest especially where the hot winds may suddenly ripen a large crop. The power of such a machine for the purposes of the colonists is equal to the labour of fifty or sixty good men. Indeed, in this colony where crops so suddenly get ripe, and where the straw is so little worth, the value of this machine is scarcely calculable."

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(36)

"Register," 16*th December*, 1843, *page* 2, *col.* 5, *Sub-editorial.*

Mr. John Ridley's Reaping, Thrashing and Winnowing Machine.

"On 2nd September last Mr. Ridley first suggested through the medium of this Journal the possibility of constructing a machine for reaping, thrashing and winnowing wheat at one and the same time and got well laughed at for his pains. Nothing daunted, however, Mr. Ridley applied himself unaided to the task and has now succeeded not only in triumphing over opposition, but in quelling even scepticism itself. Mr. Ridley's machine has now been put to the test and within the last seven days has reaped and threshed upwards of seventy acres, that is upon an average an acre per hour for ten hours in the day. A full description of the machine itself and of the manner in which it works shall appear in some future number of this Journal and it may, therefore, be sufficient for the present to observe that its extreme simplicity of construction and certainty of action has excited universal admiration in all who have seen it—from the Governor downwards.

"By this machine, reaping and threshing is not more expensive than that of sowing and harrowing and Mr. Ridley we understand would contract to do any quantity at five shillings per acre. An immense additional breadth of wheat will, it is believed, be sown next year in consequence of this invention. Mr. Ridley has deserved well of the colonists and they will we trust adopt some plan of making him an early and suitable acknowledgment."

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(37)

"Observer," 16*th December*, 1843, *page* 5, *col.* 1.

"On the 18th November we announced that a further trial of Mr. Ridley's threshing machine (or which we think might be more properly designated his 'harvest machine') had established its success. Yesterday we had the pleasure to witness its

real performance upon a large scale in a harvest field comprising two preliminary sections of something short of 268 acres of wheat from which the ears are being plucked and thrashed at the rate of fifteen acres per day. The decapitated straw which is left erect in the wake of this singular machine forms a strong contrast to the standing crop and has drawn many exclamations of surprise from the uninitiated visitors among the many whom a laudable curiosity has attracted to the sections.

"Mr. Ridley's invention will not yet realise all that has been said or sung, but number one (although necessarily defective and like almost all experimental machines, hastily and often rudely put together) has accomplished as much as to obtain ample credence for the additional pretensions of number two now in course of construction and the indomitable application and skill of the inventor are already so much appreciated that a public dinner or some other mode of expressing the approbation of his fellow colonists has been talked of. The simplicity of the machine is at once its most remarkable feature and its greatest recommendation, the principal component parts being two cog wheels, a leather belt and a drum which is driven round by a single motion. So far the operation is nearly perfect, as little corn being wasted in harvesting as by mowing or reaping and the labor not being greater than that required for mowing or reaping and in our opinion no recent invention has tended so materially to abbreviate the toilsome manual labor so irksome to Europeans in these warm latitudes.

"At present one man drives the horses and another directs the steering apparatus, but Mr. Ridley thinks the latter may be so simplified as to enable the same man to drive and guide. The threshing, winnowing and bagging will eventually be completed in the field by the contemplated additions and improvements. Thus Mr. Ridley's continuing efforts have successfully combated mechanical difficulties hitherto considered unsurmountable and the turn of a straw will literally ere long dissipate an accumulation of prejudices to this as well as to other pieces of machinery for the abridgment of human labor and to which man alone would put limits although he admits no bounds to his inventive faculties."

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(38)

"Observer," 23*rd December*, 1843, *page* 4, *col.* 3.

The Harvest Machine.

"The value of Mr. Ridley's harvest machine to the agricultural interests of the colony seems to be admitted on all hands and by its application there is no reason why we should not now become one of the cheapest corn producing countries in the world, or why our widespread plains with all their alleged disadvantages should not be still more extensively put under crop. We have not heard whether any steps have been taken towards a public demonstration of the importance the colonists attach to Mr. Ridley's invention; but we would suggest that whatever ephemeral compliment be paid him his talent ought to be rewarded by something more permanent and substantial than a public dinner. In a word, means should be taken to render Mr. Ridley's machine the property of the colony by such a pecuniary vote from the Legislative Council at its next sitting as would justify the inventor in a withdrawal of the caveat he has lodged with His Excellency for transmission to England.

"Without pretending to know anything of Mr. Ridley's views in reference to such a suggestion we should think he has patriotism sufficient to be content with the sum of £200, and if so we think a vote to that amount would be readily acquiesced in by every contributor to the Colonial Exchequer."

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(39)

Official Copy of Despatch, page 608.

No. 163, Miscellaneous Enclosure No. 1.

Government House, Adelaide,
15th November, 1843.

My Lord,—In reference to my previous Despatch No. 134 in which I had the honor to state the reasons which induced me to transmit to your Lordship certain caveats forwarded to me by inhabitants of this Province, I now have the honor to enclose a caveat, in the usual form, from Mr. John Ridley. The object of this caveat is to prevent a Patent being granted to any persons for an invention for reaping corn by thrashing the ears of the standing crops.—I have the honor to be, etc.,

(Sgd.) G. GREY.

(40)

Copies (40-42) of the Original Official Documents in the South Australian Archives Group 1053/12.

To E. S. Wheeler, Esq.

Downing Street,
26th April, 1844.

Sir,—I am instructed by Lord Stanley to acquaint you, as agent for Mr. John Ridley, of Adelaide, in South Australia, that he has received from the Governor of that Colony a Caveat from Mr. Ridley against the grant of a patent to any persons for an invention for reaping corn by thrashing the ears of the standing crops. Lord Stanley having called on the Attorney and Solicitor General for their opinion as to the steps which it would be proper to take in regard to cases of this nature has received a report from these Officers to the following effect, viz., that, according to the practice which prevails in this country relative to patents, a person entering a caveat against the granting of a patent to another party is entitled to notice of any application for that purpose for 12 months from the date of his caveat to enable him to appear and oppose the grant, if he should think fit to do so, but that notice of his intention to oppose must be given within 7 days from the date of the application, otherwise the patent is allowed to the party applying for it; that it is utterly impossible that this action could be given to or by any person residing in South Australia, and that any person residing abroad desirous of protecting his patent rights in England or securing the benefit of any invention should appoint an agent authorised to act on his behalf to whom, and by whom, the necessary notices may be given and received, a plan very generally acted upon by persons residing out of the United Kingdom. Lord Stanley has communicated this opinion to the Governor of South Australia for his information and guidance.

I have the honor to be,
(Sgd.) G. W. HOPE.

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(41)

London, 29th April, 1844.

To Right Honourable Lord Stanley.

My Lord,—We were on Saturday favoured with Mr. Hope's letter of 26th instant transmitting to our E. S. Wheeler as the agent of John Ridley, of Adelaide, a report from the Attorney and Solicitor General concerning a caveat lodged by Mr. Ridley with the Governor of South Australia. We respectfully beg to apprise your Lordship that our full instructions from Mr. Ridley are on board a vessel from Adelaide now overdue but we daily expect his letters, and meanwhile we would submit that any difficulties from Mr. Ridley's residence in Adelaide are obviated by his appointment of our E. S. Wheeler as his Agent (as further evidenced by Governor Grey's despatches to your Lordship), who can receive any notices or communications for Mr. Ridley, and we further submit to your Lordship's consideration that this caveat as concerns Great Britain might take effect from the date of your Lordship receiving the official despatch from Governor Grey and during the subsequent twelve months any notices of other applications for a similar patent should be transmitted to our E. S. Wheeler as representing Mr. J. Ridley.

(Sgd.) E. S. WHEELER & CO.

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(42)

Downing Street,
9th May, 1844.

To Messrs. E. S. Wheeler & Co.

Gentlemen,—I am directed by Lord Stanley to acknowledge the receipt of your letter of the 29th ultimo, addressed to His Lordship relative to a caveat lodged by Mr. Ridley with the Governor of South Australia.

Lord Stanley desires me to acquaint you in reply that on a subject of this nature it is not in his power to afford any assistance to you, or for the gentleman for whom you act, and that his Lordship is not aware that there is any obstacle to your adoption of any step for the protection of your employer's interest which is generally competent for the agent of an absent party to adopt.—I have the honour to be,

(Sgd.) G. W. HOPE.

(43)

"Observer," 15*th March*, 1845, *page* 7, *col.* 1.

To the Editor.

Sir,—The favourable results which have attended the use of machinery in the in-gathering of the corn during the past harvest having been brought so prominently before the notice of the public, I feel it a duty which I owe to myself to trouble you with the following remarks on the origin and history of an event which has proved of such value to the colony.

On 19th June, 1843, "pursuant to public announcement, a meeting was held at Payne's hotel, called by the Corn Exchange Committee, to examine reaping machine models, plans and drawings, and to adjudicate thereon." (See "Adelaide Observer" and other papers.)

That meeting I attended, and having been long before firmly persuaded that no machinery could be profitably applied to standing corn in this climate except it attacked the ear alone I then and there presented a model of a machine to be constructed with such a view. Its principles consisted of an iron comb, and of revolving beaters moved by belts connected with the motion of the carriage wheels.

Although many ingenious plans were placed before the Committee, by no other person than myself was a machine combining the above essential principles proposed or produced either at the meeting in question or at any of the subsequent ones which took place by adjournment. I beg to refer you to your paper containing the report of the meeting, in which you will find the observations I made upon my plan, and my expressions of confidence in its ultimate success.

Not being myself a constructor of machines, and from particular circumstances not prepared at that time to have one made under my directions, I was obliged to rest satisfied with placing the matter simply but fully and unequivocally before the public, in the earnest hope that through the instrumentality of others the benefits I foresaw in its adoption might be effected. That hope has been amply realised.

I must here, and with much pleasure, bear testimony to the great credit which is due to Mr. Ridley for his spirited exertions in bringing into action machines constructed on these principles. But whilst I concede to him all the honour which he has earned in this matter, I cannot lose sight of the fact that I came forward at the public call and presented a skeleton model, and explanations containing those principles which have been so successfully employed by him.

Having now had the experience of two years in the use of these locomotive harvest machines, I shall be happy on a future occasion to furnish you with some remarks upon their application.

It is now universally admitted that a machine similar to the one I proposed, though not at the time adopted by the Committee, is the only one by which corn can be profitably gathered—this is sufficiently proved by the great number which have been this year constructed on the same principles by various makers.

I feel it right also to state that many months anterior to the meeting in question I had imparted to several of the most influential gentlemen my ideas. Having experienced some inconvenience and even annoyance from my known connection with this subject, now that the ordeal of trial is over, and none of the evils anticipated by some having befallen it, I may, I am sure, be very fairly allowed to come forward and claim from my brother colonists the honour of having been the originator of a revolution in rural economy which will prove of inestimable advantage to our common country.—I am, Sir, etc.,

Blackwood, Mount Barker, 6th March, 1845. (Sgd.) J. W. BULL.

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(44)

(Original in South Australian Archives.)

Mr. J. W. Bull.

Sir,—From all I know or can recollect about the origin of what is called Ridley's Reaping Machine, I have no hesitation in stating there is not a single original idea in the whole machine that Mr. Ridley can claim as his own. I assisted in the construction of the first machine that was made at Mr. Ridley's place—and I never considered that any thanks were due to Mr. Ridley beyond the carrying the thing out which few in the colony as mechanics were able to do in a pecuniary point of view.

I consider that you were the first to originate the idea of threshing the corn as it stood in the field, and that though a number of models and plans were submitted for examination all of them proposed to cut the crop—and I also may state that Mr. Ridley was one of the Committee to judge and did not offer any plan or model whatever—and that he so far approved of the plan I showed as to offer to go half the expense of getting it up on condition that he might have half the benefits which might be derived from it.—I am, Yours respectfully,

(Signed) SAMUEL MARSHALL.

24th November, 1875.

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(45)

"Advertiser," 22nd March, 1876, page 5, col. 4.

Who Invented the Reaping Machine?

To the Editor.

Sir,—As a number of letters have appeared in the papers relative to the invention of the stripper, will you be good enough to publish the following. In the year 1843 I lived in Blyth Street, and carried on my business there. I may well remember all about the meeting at Payne's Hotel in September, 1843, where a number of models were shown of harvesting machines and that Mr. S. Marshall and Mr. J. W. Bull had models there, for I afterwards made the beaters and comb, with other iron work, for the machine which Mr. Marshall made for Mr. Bull. I had also some heavy mill work to do for Mr. Ridley about that time, so I remember all the particulars.

I think that Mr. Bull should have the credit of the invention for threshing a standing crop, and for having given it for the benefit of the colony. I made the mould for the teeth of Mr. Bull's machine, which were three-cornered like a bayonet, and told Mr. Bull that shape was the best that could be used, and so it is in a heavy crop.—I am, Sir, etc.,

(Sgd.) J. G. COULLS.

Athelstone, 21st March, 1876.

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(46)

Certification on Mr. James Allen's Letter. Copied from MS. in South Australian Archives.

Adelaide, 23rd March, 1882.

My dear Mr. Bull,—I was very intimate with Mr. Ridley at the time of the exhibition of the Reaping Machine Models, in 1843, and have a distinct recollection of his having stated to me more than once or twice that he had availed himself of all the best points in the Models exhibited for the construction of his machine, of those in yours among the rest. I was an exhibitor myself on that occasion, and, therefore, took more interest in this matter than I should otherwise have done, and the reports which appeared in the "Register," of which I was then Editor and Proprietor, were furnished by myself and are entirely trustworthy. Until now informed by you I never understood that anyone doubted that you had quite as much to do with the projection of the Reaping Machine which has been of so much use to the Colony as Mr. Ridley.—I am, yours very truly,

(Sgd.) JAMES ALLEN.

[I hereby certify that the above is a true copy of Mr. James Allen to Mr. J. W. Bull.

(Sgd.) Percival E. Hoare.]

Note:—Percival E. Hoare was an accountant and collector of old South Australian records. As he was a collector it is reasonable to assume that the original was in his possession and retained by him.

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(47)

To Mr. J. W. Bull. 20th November, 1875.

Sir,—In reference to your being the inventor of the reaping machine, I can say that in the year 1842 I was carrying on farming persuits in the district of Mount Barker, in your neighbourhood. On one occasion in the above year, during a discussion we were engaged in as to how we should in the coming harvest meet the labour difficulties, you informed me you had thought of a plan to do the reaping by a machine

to act on the ears of the standing crop. Your views I considered at that time to be rather Utopian. I subsequently heard (i.e., in the early part of 1843) that you had procured a working model of your plan, which you intended to exhibit at a meeting advertised to be held in Adelaide. At that meeting I was present with others, and saw your model, which I and some present admired. I did not at once understand why you did not yourself bring it to a practical issue, until I heard that financial difficulties were the cause. At the ensuing harvest Mr. Ridley had a machine in the field which I went to inspect, and at once saw it was the adoption of your model. At the time, to do Mr. Ridley justice, I did not hear that he claimed to be the inventor. There can be no two opinions but that South Australia is indebted to you for being the designer of the reaping machines, which have proved such a success.

(Sgd.) W. S. WHITINGTON.

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(48)

Circumstances under which the idea of the Stripper was conceived by J. W. Bull, extracted from "Early Recollections and Experiences of Colonial Life," pages 237-8.

"I will now give an account of my own experiences in the harvest of 1842-43, and in the conveyance of the crop to market. Prices had fallen considerably and buyers were scarce. My crop was in condition for hand-reaping before the end of December, but I could not procure reapers before the 24th, as men had been earning large wages on the plains. Harvesting hands had been so scarce that the soldiers had been allowed to lay down their arms and take up sickles and many soft-handed gentlemen had also turned out to give their doubtful but well-intended assistance in the emergency. On the 24th December, 1842, I was able to induce five men to accompany me and I conveyed them to the farm. I did not allow them to work on Christmas Day, but they had Christmas fare. I engaged to give them 15s. and one bottle of rum an acre, with rations, for hand-reaping. The crop was dead ripe, the heads drooping with the weight of the plump grain. On the 25th a fiery hot wind was blowing, and continued on the following day when I expected the reapers to start work, but they were missing. I found them at the nearest grog shop. After some trouble I got them away to start work on the following morning. Before a sickle was put into the crop, the loss in shed wheat was over one bushel to the acre, and a further loss necessarily followed in harvesting.

Immediately on my return I took one of the men, the most sober of the lot, to see the over-ripeness of the crop, and by what transpired it will be seen how providentially, out of the difficulties of my situation, the idea flashed upon me as to the possibility of thrashing a standing crop of wheat, and which idea, on being worked out, has since wrought such a beneficial result for the Colony at large.

On taking this man into the crop, and pointing out to him its over-ripeness, and how careful they would have to be in performing their work in handling the standing crop and in binding, calling his attention to the shed grain on the ground (I was standing a short distance within the crop), and to show how tender the heads were, with the full grain staring us in the face out of the gaping chaff, I passed my left hand with my fingers spread, under and just below the ears, allowing the straws to pass between my fingers, the ears being close to the palm of my hand. I then struck the heads with a sweep of the edge of my right hand, and held out my open hand for the man to see the clean threshed wheat in the hollow of it, most of the chaff having been carried away. (I must here mention that before this occurred I had for many weeks been pondering over plans for applying machinery to a standing crop, and had passed many sleepless hours in bed, and had been remonstrated with by my good wife, who said I should lose my senses.) Before I moved from my position in the standing corn, I stood in a sort of amazement and looked along and across the fine even crop of wheat. The ideas I had in vain sought for now suddenly occurred to me, and I felt an almost overwhelming thankfulness. I did not move, but sent the man for a reap hook and caused him to cut me a small sheaf of wheat which I took into the barn. There, holding a bunch of it in a perpendicular position, I struck the ears with a circular sweeping blow upwards, using a flat and narrow piece of wood, and found the threshed grain to fly upwards and across the floor; and thus I satisfied myself that the grain would bodily fly at a tangent up an inclined plane when struck by beaters and that a drum, as in a threshing machine, would not be required to complete the threshing, and so felt I had gained the correct idea for a field thresher, and

that a segment below the beaters would be apt to cause the wheat to be carried round and so be lost. All this occurred in 1842.

I afterwards lost no time in exhibiting a rough drawing to many of my neighbours (some of whose certificates I hold, see appendix), but I got no encouragement, but from my oft recurrence to the subject was sometimes told I had lost my senses."

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(49)

"Southern Australian," 21st March, 1845, page 2, col. 5.

Editorial in Reply to Mr. Bull's Letter dated 15th March, published 21st March.

"In another column will be found a letter from Mr. J. W. Bull of Mt. Barker, in which he claims the honour of inventing the above machine. The first mention of this machine was made in the local newspaper about the beginning of September, 1843, and the present is the first public intimation of a claim by Mr. Bull to its prior discovery while all along from that time Mr. Ridley has openly claimed and received the honour. In these circumstances we cannot help thinking that Mr. Bull has either been miraculously modest or that he is now sufficiently hardy.

The matter, however is too important to be passed over in silence and we have accordingly made careful enquiry in reference to the claim made by Mr. Bull.

On looking into the newspaper files we find that on Saturday 2nd September a letter under the signature of a 'Wheat Grower' was published in the 'Register' mentioning the machine. We met Mr. Ridley immediately afterwards, who stated that the idea was his and that the 'Register' had inserted it in the form of a letter. On the 5th September we published the following:—

'It is the part of wise men to provide for the worst. There is a possibility that ere the harvest season arrives the colony may be provided with an accession of labor, but as this is a contingency we are glad that our farmers and others are endeavouring in various way to limit the amount of manual labour required in getting in the ensuing crop.

Among the various machines which have been proposed we have the greatest gratification to announce that one has been discovered by an enterprising ingenious and practical colonist which there is every reason to think will save labour and expense in reaping and threshing corn in an incalculable degree. The following are the particulars of the scheme which have been published in the 'Register' in the form of a letter:—(here follows 'Wheat Grower's' letter—appendix 22.)

We may add that the inventor intends immediately to have a machine made on the above principle and if it succeeds it will doubtless be extensively used in the colony as straw is at present of comparatively little value.

The 'Observer' of 2nd September mentions several machines one of which had been suggested by the casual inspection of some wood cuts of implements by the ancient Goths.

With reference to ancient implements, we are aware that several parties in the colony had in view a machine similar to that described in the following extract from 'Loudon's Encyclopoedia of Agriculture' (page 26). (Here follows the extract from Loudon's Encyclopoedia, appendix 23.) 'A reaping machine . . . the board on the fore part is lower than the others, upon it there are a great many short teeth wide set in a row . . .'

The difficulty was, as to how the ears were to be taken off after being seized by the teeth.

This difficulty was proposed by Mr. Ridley to be overcome by beaters. The first public intimation of this connected with Mr. Ridley's name was on Tuesday, 12th September, at a public meeting at Payne's Hotel, where according to the 'Oberver' report a friend of Mr. Ridley stated his invention comprised both reaping and threshing.

On Tuesday, 19th September, two adaptations of the ancient mode of threshing were presented to the Reaping Committee. One of them was by Mr. Emmett on behalf of Mr. King of Gawler Town, who proposed to cut off the ears by revolving knives: the other was by Mr. Bull, who proposed revolving beaters—in fact the same principle as had been mentioned by Mr. Ridley in the 'Register' of the 2nd September. At the time, however, Mr. Bull brought forward his plan, Mr. Ridley's machine was nearly constructed.

At this time also we mentioned to the public Mr. Bull's idea of fattening sheep by the ears of corn cut off by machinery in the way proposed by several inventors.

We saw Mr. Bull in reference to his fattening scheme and he afterwards wrote to us a long letter upon the subject which we published, but at that time—though an excellent opportunity—he did not lay claim to the invention of Mr. Ridley.

The conclusion we have come to on the point is that Mr. Bull *may have* discovered the application of beaters to the Gallic implement, but that Mr. Ridley is entitled—not only to the honour of independent discovery, but to the highest merit for his unwearied diligence, patience, skill and enterprise in constructing and carrying into effectual operation one of the most important machines which has ever been used for the benefit of agriculture and of mankind.''

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(50)

''*Southern Australian,*'' 19*th September*, 1843, *page* 2, *col.* 3.

Latent Genius.

'' . . . . . We have also heard of another valuable idea which has been discovered by Mr. J. W. Bull, of Mount Barker.

By cutting off the ears of corn as proposed by several inventors, the wheat will cost only 1/10d. per bushel. Mr. Bull's plan is to fatten sheep with the wheat during summer so as to render them fit for boiling down which could not otherwise be accomplished in that season.''

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(51)

''*Southern Australian,*'' 22*nd September*, 1843, *page* 2, *col.* 1.

Rural Economy—Fattening Sheep with Wheat.

''In our last publication we mentioned that Mr. Bull, of Mount Barker, had formed an idea of feeding sheep with wheat. Since then we have seen Mr. Bull and as we find that his principle has not been fully explained we shall now in justice to him lay his plan before the public.

''It has been ascertained that sheep fatten very quickly on wheat when taken along with chaff, rape or some other corrective. Sheep for instance put into a field of stubble have been found to improve with extraordinary rapidity. Mr. Bull's plan then is to reap the ears of wheat, with a machine, afterwards at leisure to mow down the straw and to feed the sheep with the unthreshed ears, and he guarantees to fatten a sheep in six weeks with a bushel of wheat, so that an animal previously worth only five shillings shall at the end of that time be worth ten shillings at least for boiling down, thus by the process converting the bushel of wheat into five shillings worth of fat. He calculates that the wheat in ear so cut will at Mt. Barker cost the farmer 1/2d. and on the plains 1/10d. per bushel, the difference between these sums and the increased value of the sheep being clear gain, besides the large quantity of excellent manure which the farmer acquires by the operation.

''We simply state the above facts without expressing an opinion. We may add, however, that Mr. Bull mentions that his scheme has been very generally approved of, and that he has had many offers of sheep and money to enable him to carry through his experiments. If these prove successful, the farmers' position and prospects will certainly be immensely improved.''

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(52)

''*Observer,*'' 5*th April*, 1845, *page* 5, *col.* 3.

''To the Editor of the Adelaide 'Observer.'

Sir,—Perceiving in the 'Southern Australian' a long leading article commenting on my letter explanatory of my connection with harvest machines and also a notice in the 'Register' promising insertion of an article on the same subject, I merely deem it necessary to state through your widely circulating paper that if Mr. Ridley will avow the 'South Australian's' article as representing his claims correctly, or come forward in a public manner to endeavour to contravert any of my statements, I shall then and in either of these cases feel that I may with safety reply. In the meantime I shall be happy to trouble you with such a list of names confirming dates, etc., as will substantiate the points of my former letter as early as I can procure authority for publishing them.—I am, Sir, etc.,

Blackwood, Mt. Barker, 2nd April, 1845. (Sgd.) J. W. BULL.''

(53)

"Observer," 5th April, 1845, *page* 5, *col.* 3.

Editorial Comment on Letter from Bull in same issue.

"In giving insertion to the following letter from Mr. Bull we cannot but express our regret that any angry discussions should have arisen with respect to the original invention of the harvest machine now known as Mr. Ridley's. We fully believe all that Mr. Bull has stated, but inasmuch as precisely similar ideas may have been entertained by more than one individual contemporaneously with Mr. Bull's avowal of his plan, who is to say that Mr. Ridley with his nice mechanical discernment and close application to whatever he attempts, might not have become convinced that the only plan likely to succeed was the one which he has so successfully carried out."

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(54)

"Register," 19th November, 1845, *page* 2, *col.* 4.

"The energetic and persevering proprietor of the Hindmarsh steam mill* has nearly completed seven new harvest machines this season. One of them is a large double-acting one. It is nearly seven feet in width and both wheels are geared to work the beaters. The other six are the size of Mr. Ridley's former machines, but more perfect in their construction; in fact the new machines appear as if they were capable of saving even the smallest grains in the field to be submitted for their operation . . .

The proprietor has contrived very ingenious and expensive machinery by which the teeth of the combs are made with great perfection and regularity. The iron wheels of the new machinery are made on the suspension principle . . ."

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(55)

Extract from "A Backward Glance," page 115—*Annie E. Ridley.*

SOUTH AUSTRALIA.

Extract from the Minutes of the Proceedings of the Legislative Council.

Tuesday, 21st December, 1858.

"Resolved:—'That the thanks of this House be conveyed to John Ridley, Esq., as a recognition of his claim to the gratitude of the South Australian community for his invention of the reaping machine.'

A true extract.

(Sgd.) F. C. SINGLETON,
Clerk of the Legislative Council."

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(56)

"Register," 21st December, 1875, *page* 6, *col.* 5.

"Dear Sir,—In travelling through the country at this season of the year one cannot fail to be deeply impressed with gratitude to divine providence for the prospects of a bountiful harvest visible on all sides, and at the same time one cannot fail to be impressed at the easy and expeditious means used for its ingathering. In all directions we see the Ridley reaper doing the work of hundreds of hands and gladdening the heart of the farmer as on each round it comes humming home to the garner with its load of solid wheat. Allow me to express my strong opinion that the value of this invention has never been sufficiently recognised by the public, and especially by the farmers and machine makers of the colony, who have benefited so largely by it, and to suggest a means by which Mr. Ridley's ingenious invention may be permanently memorialized. The best means of giving practical effect to the idea will be, I should think, through the Royal Agricultural and Horticultural Society. The proposal is this—Let application be made to every farmer and machine maker in the colony for a contribution according to his means towards a fund for creating a Ridley Scientific Scholarship in connection with our University. I should hope that as this is a most prolific season one general contribution would produce the requisite amount; but should it fail to do this the Treasurer's books might be kept open for a year or two longer. I hope my idea may be thought worthy of notice at the Davenport Banquet, and that the result may be the paying of one more fragment of honor to one to whom honor is due."—I am, etc.,

(Sgd.) G.

* John Ridley.

(57)

"Register," 27th December, 1875, *page* 6, *col.* 5.

"Sir,—The letters in your paper of the 21st instant on the extensive use of the reaping machine in this colony, call for a few remarks from me. I will in the first instance state most distinctly that I have no desire to detract in any way from the credit properly due to Mr. Ridley for carrying out to a practical success my original invention. In yielding to Mr. Ridley, honour for his share in producing an implement which has so greatly aided agricultural operations I may with propriety claim that the honour should be divided, because the principle and the details which he adopted were in all essential respects those which I alone previously exhibited in competition for a prize offered by the Reaping Machine Committee. To prove this more fully, I must go back to the harvest of 1842-43, but I will be as brief as possible. The wheatgrowers of that season now in this land, will, with me, remember that the yield was about 40 bushels an acre, and was saved with the greatest difficulty for want of hands. To overcome this difficulty a few gentlemen in Adelaide (to be honourably mentioned) subscribed a sufficient amount to offer a reward of £80 for the best harvesting machine, and a committee was appointed, which sat at Payne's Hotel (now called the Exchange Hotel) and met in the month of June (sic) 1843, to receive plans and models and to award the prize to the best invention produced. I was one of the exhibitors. My model showed beaters to act on the standing corn above a projecting comb—the beaters to be driven by a belt or belts, or by gear connected with the wheels of the carriage. My design did not gain the prize, which was given to a Mr. W. Murray for a cutting machine, which when constructed was never taken into the field. My model was left in the office of Messrs. Hamilton and Henderson (our first City corn merchants) for public inspection. Their clerk—Mr. Thornber—had acted as hon. secretary to the Committee. I should mention that Mr. Ridley was present when I exposed my model, and it is said he was called in to act as a judge, but this I do not know and scarcely believe, as shortly after the meeting he met me and expressed his approval of my design. I referred him to my model and left him without stipulation to carry out my idea as it was then out of my power to get a machine constructed. I returned to my home in the Mt. Barker district, a disappointed man, having passed many sleepless nights in devising my production. But I shortly afterwards, by the advice of friends, employed Mr. S. Marshall, then of Currie Street, now of Rundle Street, to make me a machine which I successfully worked during the following harvest, and until I gave up farming. I have never denied Mr. Ridley's claim for consideration at the hands of our fellow colonists, but I must modestly assert that I have a just claim to divide honours."

(Sgd.) J. W. BULL.

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(58)

"Register," 15th January, 1876, *page* 6, *col.* 3.

To the Editor.

Sir,—Having seen in your issue of January 1st a letter from Mr. J. W. Bull relative to the invention of the stripper, I wish to state that I am an old colonist of 35 years. The credit of originality has always been universally acknowledged due to that gentleman by all the early colonists connected with wheat growing, though Mr. Ridley brought it into practical use. The merits of the stripper are too well-known to need comment. With the uncertainty of our climate and crops with a scanty population, I feel certain no machine yet invented could fill its place, as almost the poorest crops can be saved with the use of comb and beaters.

Several gentlemen with whom I have recently spoken have expressed a strong desire to enter into any plan to substantially reward with something more than the honour an old and respected colonist who has so largely contributed directly or indirectly to the success of the entire population of South Australia, and I feel certain the people of this colony, more especially the farming community, would not be found backward in so good a cause, if called upon to subscribe to a thing so deserving of recompense.—I am, Sir, etc.,

(Sgd.) C. F. HERBERT,

Port Wakefield, January 13th, 1876. Farmer.

59

"Advertiser," 16*th February*, 1876, *page* 6, *col.* 5.

Who Invented the Stripper?

To the Editor.

Sir,—"Will you kindly insert the following, it being a matter of public interest at the present time:—The comb and beaters—the reaping machine—Who was the inventor? In the year 1843—the writer was then living in Adelaide—there was a large breadth of land under wheat crop at that time. Labour being scarce, it became a question how the crop was to be secured. At a meeting called for the purpose it was resolved to invite persons to exhibit models of machines to save labour and the crop. I well remember reading in the newspapers that Mr. J. W. Bull proposed a machine with comb and beaters to harvest a standing crop, and to utilise the straw by feeding sheep thereon. I have not the least doubt but Mr. Bull was the inventor, as nothing was heard of such a machine before that time. At a Committee meeting held shortly after at Payne's Hotel, to inspect models, Mr. Bull exhibited his, the only one, with comb and beaters. What has been the result of the invention? Has not that machine given profitable employment and wealth to thousands, established agriculture on a solid base, effected the opening up and settlement of the country in all directions? It has also greatly increased the value of the public estate, as seen by the land sales and constant flow of money into the Treasury; it has increased trade and the prosperity of the colony generally. I think this a most fitting time, and I trust my fellow colonists will mark in a suitable way the great services rendered them by their greatest benefactor, the inventor of the comb and beaters—the reaping machine."—I am, Sir, etc.,

(Sgd.) SEPTIMANE HERBERT.

Wissanger, Yankalilla, February 10th, 1876.

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(60)

"Register," 17*th February*, 1876, *page* 6, *col.* 2.

"Sir,—An effort is now being made to deprive Mr. Ridley of the credit due to him for constructing and introducing to public notice the reaping machine, of which all existing strippers are variations or improvements.

Permit me to state that in the first harvest reaped after Colonel Gawler left the Colony, December, 1841, Messrs. Borrow and Goodiar had a large area of wheat adjoining the South Park Lands. In reaping this by sickle a very large portion of the wheat was shed and lost. Many who witnessed it thought the loss so great that wheat would not pay on the plain if reaped by hand. The matter was so important that it was the one topic of conversation in Adelaide. Search was made for information as to harvesting machines that might meet the difficulty and in 'Loudon's Encyclopaedia of Agriculture' was found—and I suppose may still be seen—a drawing of a machine described by Pliny as being in use by the Belgians when invaded by Julius Caesar. It was a cart on two wheels with a comb along the top of its tail board, a horse or bullock was in the shafts with its head towards the body of the cart, which it pushed before it into the wheat; the wheat was gathered by the comb and a man walking by one end of the comb with his left hand on the cart, had a stick in his other hand with which he thrashed the wheat into the cart, as it came against the head of the tail-board. Mr. Ridley's attention being directed to that drawing, he by the next harvest produced his machine, by adding the beaters driven by an endless band attached to the wheel that carried the machine. I was present at the harvest I have alluded to. I never doubted that Mr. Ridley himself conceived the idea of the beaters and endless band.

In Sydney in 1854, in England in 1859 and at various times in this Colony and in Victoria, I have thus described as of my own knowledge the great benefit Australia has derived from Loudon's Encyclopaedia adapted and utilised by Mr. Ridley's natural turn for mechanics, and until I get proof from Mr. Ridley himself, or under his hand, I shall continue to give him sole credit for his invention and adaptations, no matter how many other people may have thought out similar ideas without having given the public the benefit of them when they might have been useful, and now after 30 years silence bring them to light to deprive Mr. Ridley of that credit."—I am, Sir, etc.,

February 17th, 1876. (Sgd.) JNO. B. HUGHES.

(61)

"Register," 23*rd February*, 1876, *page* 6, *col.* 3.

Who Invented the Stripper?

"Sir,—I shall esteem it a favour to be allowed to answer Mr. J. B. Hughes' letter of the 17th instant. Mr. Hughes in his first sentence makes a mistake in saying 'an effort is being made to deprive Mr. Ridley of the credit due to him for constructing and introducing to public notice the reaping machine.' On this I remark, that all the gentlemen who have written to the papers or to me affirming that I am the inventor, give Mr. Ridley in other words just the same credit and honour as Mr. Hughes awards him. In my letter, which you obligingly published on the 1st January, I said 'I have no desire to detract in any way from the credit properly due to Mr. Ridley for carrying out to a practical success my original invention.' I must beg further to correct Mr. Hughes. He has evidently lost sight of the meeting of the Reaping Machine Committee which sat in the month of September, 1843, with Alderman Peacock in the chair, as he states in his letter that Mr. Ridley brought out a machine in 1842. The fact is no machine for harvesting wheat was constructed until after the above meeting in September, 1843, at which I exhibited my working model, and Mr. Ridley was present as a spectator. I quote part of the report of that meeting as far as I appear:—'Mr. J. W. Bull, of Mt. Barker, was now introduced. His machine consisted of a long tooth comb fixed to the back of a close-bodied cart, the teeth being operated upon by four revolving beaters with square edges, which would have the effect of taking off the ears and depositing them in the body of the cart. Mr. Bull explained not only the principle of his invention, but their diversified beneficial application.' I beg to add that when my model was rejected, I, the next day, placed it in the office of Messrs. Hamilton and Henderson with their chief clerk, Mr. Thornber, as a gift to the Colony, and open for any colonist to adopt. Mr. Ridley was the first to do so. I should state that the model was made under my directions by the late Mr. T. H. Beare, who accompanied me to the meeting. A machine was shortly aftewards built for me by Mr. Marshall, and was first worked by Mr. W. L. Beare, J.P., on his father's section at Netly, and I hold a letter from him to that effect. I may remark in conclusion that I have always quietly maintained my right to the honour of having invented the stripper.—I am, Sir, etc.,

(Sgd.) J. W. BULL,

Adelaide, February 18th, 1876."

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(62)

"Clare, 25th November, 1875.

My Dear Mr. Bull.—I have a clear recollection of the construction by my late father of a model of a machine for you, and entirely on your ideas. This was exhibited by you in Adelaide and you were accompanied by my father. Mr. S. Marshall afterwards constructed a machine for you, following your model, which first worked at Netly, on my father's section; the beaters were driven by a chain and leather belt.—I am, dear Sir, yours truly,

(Sgd.) W. L. BEARE."

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(63)

"Register," 29*th February*, 1876, *page* 6, *col.* 3.

To the Editor.

"Sir,—Will you allow me a small space in your paper to reply to a letter which appeared therein on the 17th instant signed 'Jno. B. Hughes.'

I well remember Messrs. Borrow and Goodiar's wheat-crop and well-built stacks as mentioned by Mr. Hughes; also, as I stated in my previous letter, the first notice of the comb and beaters by Mr. J. W. Bull. I think Mr. Hughes in error as to dates. He makes it appear that Mr. Ridley's machine was completed in 1842; I think it should be in 1843 Mr. Ridley had the advantage of 'Loudon's' work and drawing; also Mr. Bull's letter and model, which he most likely saw, and a man of his mechanical turn of mind would profit by. Was it not Mr. Ridley's intention to have patented his machine had he not been threatened by a caveat? And now after 30 years I fail to see how he is entitled to the honour of the invention if not at the time he produced the machine.

I may here remark I have not spoken to Mr. Bull for years, and I am not aware I ever spoke to him in reference to the machine or its inventor. I know less of Mr. Ridley, but respect him as an old and worthy colonist.—I am, Sir, etc.,

(Sgd.) SEPTIMANE HERBERT.

Wissanger, Yankalilla, February 22, 1876."

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(64)

"*Register,*" *4th May*, 1876, *page* 6, *col.* 2.

The Wheat Stripper.

"The claim to the invention of Ridley's Reaper is again revived by a request from Mr. J. W. Bull addressed to the Chamber of Manufactures requesting them to nominate a sub-committee to act in conjunction with a sub-committee that he is asking the Agricultural Society to appoint for the purpose of investigating and settling the dispute. The Chamber, however, decided that the matter was more within the province of the Agricultural Society, and therefore they did not accede to the request made."

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(65)

"*Register,*" *22nd December*, 1879, *page* 4, *col.* 4.

Tribute Paid to Ridley.

Agricultural Education and Mr. Ridley.

"In any movement to further the cause of agriculture in South Australia it should not be forgotten that the Colony owes a debt of gratitude, which it has never repaid, to the inventor of the harvester which has brought about so great a revolution in farming, and has contributed so materially to the prosperity of the Colony. When giving a few days ago an account of the Ridley reaper we pointed out the magnitude of the benefit which the machine had been to the country, and the patriotic manner in which the inventor made a present of the fruits of his genius to his adopted land. He might have turned it to great profit, but he was too liberal minded to place any impost on the farmers. Mr. Ridley has received many expressions of thanks from the public and the Legislature, but Parliament has not been disposed to make him any tangible recognition of his services. It is fair to add that Mr. Ridley has not only never sought for any reward, but has, on the contrary, testified that any pecuniary recompense would not be agreeable to him. The only money ever presented to him he handed over to a public institution. His chief reward has consisted in the success of his invention, and the inestimable benefit it has conferred upon the country. The progress of agriculture in South Australia must be more gratifying to Mr. Ridley than any pecuniary recompense.

Nevertheless, the Colony should not neglect to do him honour and testify its gratitude. So long as wheat farming is carried on in South Australia Mr. Ridley's name will never be forgotten, for he has established a monument to himself more enduring than any that can be raised to his memory by the Government. But it would be a fitting tribute of gratitude, and one which we imagine would be the most acceptable to so public-spirited a man, if his name were associated with an agricultural institution destined to further the cause to which his invention has given so great an impetus. The establishment of a 'John Ridley Chair of Agriculture,' or even of a 'John Ridley Scholarship' in connection with the University, or a 'John Ridley College of Agriculture' would be a graceful recognition on the part of the State of invaluable services rendered in a spirt of pure patriotism. It is no unreasonable thing to ask that such a useful and at the same time such an appropriate method of perpetuating his name should be resorted to, and it would add tenfold to the significance of the compliment if steps were taken during Mr. Ridley's lifetime to give effect to the suggestion we have thrown out. The object is one that must appeal forcibly to the members of the farming community, and it is well worthy of being strenuously promoted by the Royal Agricultural Society and Chamber of Manufactures, and it cannot, we imagine, fail to secure the hearty sympathy and support of Parliament."

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(66)

"*Register,*" *24th December*, 1879, *page* 6, *col.* 6.

The Invention of the Reaping Machine.

"Sir,—Knowing the impartial spirit in which your Journal has always been conducted since its first establishment, I venture to address to you, anent the article headed 'Agricultural Education and John Ridley.' After reading the article I was surprised

(without wishing to detract from Mr. Ridley's merits) that the name of Mr. J. W. Bull was not once mentioned. I have a distinct recollection of going with Mr. Bull to look at a machine which was being constructed for him by the late Mr. Marshall, at a shop which he then occupied in Currie St., nearly opposite Leigh St. This was some time in the year 1844 or 45, if I am not mistaken; it certainly was before Mr. Ridley's machine was before the public. However, the precise day can be easily ascertained. Now as far as I know, Mr. Bull's claims to the gratitude of the public of this colony which is so deeply interested in its agricultural prosperity have never been acknowledged. I think it would be only a graceful act on the part of the colonists generally, and the farmers in particular, many of whom owe their present prosperity to the introduction of the reaper, if a subscription were set on foot to present Mr. Bull with a substantial testimonial, in recognition of his valuable invention. I shall be happy to become a subscriber to a fund for that laudable purpose, and I have little hesitation in saying that there are few old colonists who will not willingly come forward to acknowledge their debt of gratitude to Mr. Bull.—I am, Sir, etc.,

(Sgd.) A. WILSON.

River Murray, Dec. 23rd, 1879."

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(67)

(Original in South Australian Archives.)

"Adelaide, July 29th, 1880.

Sir,—We are in receipt of your communication of the 27th inst., requesting us to examine various documents forwarded by you in support of your claim to be the original of the principle of reaping and threshing wheat in the field by means of a comb and beaters.

In reply, we have carefully examined the documents you have enclosed, and find that the same support your statement 'that you were the first to explain and exhibit a model of a machine on that principle.

We find that the first time the principle of a comb and beaters was made public was by yourself, at a meeting of the Corn Exchange Committee, held at Payne's Hotel, Adelaide, on September 19th, 1843, when you exhibited a model of a machine 'consisting of a long-toothed comb fixed to a close-bodied cart, the teeth being operated upon by your revolving beaters,' and that no other machine on that principle was exhibited by any other person at that time; and that after the meeting you left your model at the office of Messrs. Hamilton and Henderson, with instructions that it was at the service of the public, as you were unable to bring it out yourself.—We are, Sir, yours faithfully,—

THOMAS F. MONTEITH,
HERBERT EVANS,
JOHN HARVEY.

J. W. Bull, Esq., Commercial Chambers, Adelaide."

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(68)

"Register," 31*st July*, 1880, *page* 6, *col.* 3.

"The brief of Mr. J. W. Bull, in which he claimed to be the inventor of a harvesting machine, was received from the Hon. Commissioner of Crown Lands. It was intimated that the correspondence was very voluminous, and the Secretary was instructed to write to the Commissioner of Crown Lands to the effect that the Society (Royal Agricultural and Horticultural Society of South Australia) would have no objection to appoint a sub-committee to consider the claim if the Government would bear the expense of printing."

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(69)

S.A. Parliamentary Debates, September 5th, 1882, *col.* 844.

Bonus to Mr. J. W. Bull for Services in Improving Agricultural Machinery, £250.

The COMMISSIONER OF CROWN LANDS (Hon. A. Catt) in reply to Mr. Tomkinson, said this item had been placed on the Estimates at the request of a deputation who waited on him, and pointed out that though Mr. Ridley was the inventor of the stripper Mr. Bull had done a great deal towards perfecting it. (Hear, hear.) There was no doubt that Mr. Bull deserved this bonus.

Mr. HAINES said Mr. Bull deserved it for his perseverance, but not for being the inventor of the stripper, that honour being due and nearly always given to Mr. Ridley.

Mr. ATKINSON supported the item. He was one of the first to use Ridley's reaper; but even at that time—more than thirty years ago—it was recognised that Mr. Bull had some claims in reference to it.

The Hon. R. D. ROSS was glad that this amount had been placed on the Estimates, and he hoped that in connection with the Agricultural College the Government would establish a Ridley Scholarship or something of that kind in honour of Mr. Ridley, who did not need a money bonus, but had a claim to be remembered by the people of this colony.

Mr. TOMKINSON said he was perfectly satisfied with the item and with the explanation given.

Passed.

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(70)

"Register," 21*st January*, 1886, *page* 6, *col.* 2.

Mr. Ridley's Reaping Machine.

To the Editor.

Sir,—On reading in the Journal (Evening Journal) of Saturday last the interesting letter of your London correspondent, I was particularly struck by one remark quoted from a lecture delivered by Mr. A. Forster, who, after speaking in the strongest terms of the claims Mr. John Ridley has on South Australia for the introduction of the reaping machine, goes on to say, "Mr. Ridley is still living in London," and still further says, "For his reaping machine Mr. Ridley could take out no patent." To most of your present numerous readers the question will naturally arise—Why could not Mr. Ridley take out a patent? I desire to explain without fear of contradiction that Mr. Ridley, as reported in the year 1844, applied to Governor Grey for a caveat to enable him to obtain a patent in England, and that as reported he withdrew the application.

The report in your "Register" and "Observer" of September 23rd, 1843, was a stopper to his application. Extract from report of the meeting of the Reaping Machine Committee—"Mr. J. W. Bull presented a machine consisting of a long-toothed comb fixed to a close-bodied cart, and operated on by four revolving beaters." "Mr. Ridley was present, but not as a competitor."

I make no comments.—I am, Sir, etc.,

(Sgd.) J. W. BULL.

18th January, 1886.

(*"Evening Journal," published by S.A. "Register."*)

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(71)

"Register," 25*th January*, 1886.

"In speaking of the agricultural operations of the Colony, he" (Mr. Forster) "very properly bestows high praise on Mr. Ridley for the invention of the reaping machine, that ignores the claims of others who, Mr. Ridley himself will be the first to admit, have a right to share in the commendation."

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(72)

"Register," 6*th May*, 1886.

Sir,—After the remarks in your leader of January 25 it seems necessary for me to break the silence which has hitherto been my most dignified course. At eighty years of age these things are of little consequence to me, but still I wish to leave on record some definite statement of the truth concerning my machine, since, as my friend, Mr. Forster, says in his lecture, 'most of those who knew the facts have passed away, and men who knew not Joseph have taken their place.' For thirty years there was no question of my right to the sole honour of this invention, which, as is generally admitted, has had some share in the progress of South Australia, and from which I personally have derived none of the benefit which was my due. Not till the year 1879 was anything heard of the pretensions to which you have again given currency.

In a letter in a recent copy of your journal, I see a notice of a competition in which it is alleged that I took no part. To this I reply that I did not compete, having no wish for the £40 offered as prize, but that I was present at this meeting, and there announced that my machine was partly made, inviting inspection—an invitation accepted by several persons present. Some weeks before this meeting a letter signed 'A Corngrower' appeared in the journal of which Mr. James Allen was editor, which was the result of a communication made by me to him.

I have always said that the first suggestion of my machine came to me from a notice of a Roman invention given in Loudon's 'Encyclopaedia of Agriculture.' To this I now add the statement that from no other source whatever did I receive the least help or suggestion. And I claim from the country I have served this small return: the acceptance of this, which is in all probability the last word it will have from me.

(Sgd.) JOHN RIDLEY.

19 Belsize Park, London, 18th March, 1886.

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(73)

"Register," May 7, 1886, page 7, col. 7.

To the Editor.

Sir,—Mr. Ridley's letter in your issue of to-day has afforded me a very great deal of pleasure and satisfaction, as it is almost a verbatim confirmation of what I have repeated to scores of colonists for years, including my friend J. W. Bull. The latter I could never convince. Being closely connected with grain culture, farming, and agricultural societies from 1839 down to 1851, as a farmer and honorary secretary, it became a duty to watch every invention or matter connected with these productions. Being a near neighbour of Mr. Ridley's I often had the pleasure of inspecting the construction of these machines at his Hindmarsh workshops, and receiving the explanations he kindly afforded me in reference thereto. Like others, I confess I had some misgivings as to the probable waste, and partook of the prejudices that existed against the reaper. These were so strong that the inventor actually purchased the standing crops, and convinced us by the returns that our fears were overrated on this point. This led to a small committee of our branch agricultural society, of which I was one, being formed to examine and report. The conclusion we arrived at was this: that under the old fashioned system the waste was nearly, if not quite, as great as by the new . . .

During the times referred to I never heard of any inventor previous to Mr. Ridley, and am pleased to find my recollections confirmed by his letter. As a national benefactor, no one has ever done anything for South Australia equal in importance, not even the author of the Real Property Act. I feel a pleasure in adding my word to keep Mr. Ridley's name green among old colonists as well as future generations.

(Sgd.) HIRAM MILDRED.

Adelaide, 6th May, 1886.

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(74)

"Register," 12th May, 1886, page 7, col. 6.

"We see no reason to vary the opinion expressed by us the other day that Mr. Ridley has effectually disposed of all doubts thrown on his originality and good faith. Whatever Mr. Bull's claims to have independently found out the principle of the 'stripper' may be, Mr. Ridley has indisputably established his rights to be deemed the author of the machine which in past years has been of such inestimable value to South Australia. The subject has been so frequently discussed and the facts of the case so often explained that we cannot undertake to publish any further letters on the subject."

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(75)

"The Register," May 18th, 1886, page 7, col. 3.

Ridley's Reaping Machine.

Sir,—I see by your paper that you have got a letter from Mr. Ridley claiming to be the inventor of the reaping machine. As one of the firm of Kelly Brothers who settled near Woodside in 1840 and carried on farming for a number of years in that district, may I be allowed to mention the circumstances that led Mr. John Ridley to construct and bring into use the first reaping machine. Mr. Ridley in carrying on

business as a miller at Hindmarsh made it a part of his business during the year to go among some of the farmers, seeing their crops, how much they had in crop, and if they had any wheat on hand to try and buy it. It was on one of these visits over the hills that he called on Mr. Bull, who was farming near Balhannah, and in stopping at his house he found the book on agriculture mentioned in his letter to your paper. Dr. Godwin, a near neighbour to us, got from his father in London a number of these books. Mr. Bull had the loan of this book from Dr. Godwin, and it was from this book that Mr. Ridley got his first idea of a reaping machine. Mr. Ridley left Mr. Bull's and came to our farm and had the book with him and he showed us the picture of a machine similar to the sketch in your paper. This machine cut off the ears, but Mr. Ridley said to us—"Could not a machine be made with beaters like a threshing mill to thresh out the ears?" and he told us then that he intended or thought of making a machine with a comb to take in the ears and thresh them out. Some time afterwards, we were sending and delivering wheat at his mill at Hindmarsh. He had then two Scotchmen, machinists, planning and putting together the first machine ever made in South Australia. I was about 20 years of age at the time, and recollect all about it. I never knew that it was mentioned that any other person was making a machine at the time. Mr. Ridley got his machine together, tried it the first harvest, but I believe it did not do its work very well, and possibly the invention would have died out had not other machinists improved on it and brought it more into general use. Mr. Ridley was of an ingenious turn of mind. I recollect that we had a very fine crop of Chevalier barley. Mr. Ridley called on us, purchased several hundred bushels for the purpose of making pearl barley, but he found it would not pay, and gave it up. I am sorry to see the old man, now 80 years of age, being somewhat disappointed in trying to put him aside as the inventor of the reaping machine, and it is only to strengthen his claim that I pen these few lines to you.—I am, Sir,

JAMES KELLY.

Marocara, Riverton, May 15th.

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(76)

"Register," May 19th, 1886, page 6, col. 2.

The Reaping Machine.

Sir,—I was perfectly staggered this morning when your paper of to-day was brought to me to show me a letter from Mr. Kelly after you had closed the correspondence by a note at foot of my answer to Mr. Ridley with your verdict on the dispute, and when you had admitted a letter adverse to me like Mr. H. Mildred's of mere assertions, without dates or references. Well, as you have re-opened your columns against me, I take it I may look for insertion of this letter, but I must premise it is hard work, weak and worn out as I am, and partly paralysed and almost blind, for me to write at all. I leave your correspondents until I put in support of my previous letter the following question to the agent of Mr. Ridley and to Mr. Ridley and yourself, re the meeting at the time the models, etc., were exhibited, when Mr Ridley said he had a machine nearly finished (September 23rd, 1843). Can it be proved that the principle of such machine was a facsimile to the model I then exhibited, viz., comb and beaters? The above question I reserved and should have troubled you with had you not closed the correspondence. I have since so much wished to put it as a fair closing of the dispute that I would have sent it to you as an advertisement if I had possessed the means. Now for Mr. H. Mildred. To his bald assertions I can only give a denial, and refer him to my letter of the 7th, which appeared on the 12th, and remark I think if he had not rushed into print so unmanfully before I had time to answer Mr. Ridley, he would not have written at all or been more careful. Further, as to Mr. Kelly's incorrect letter. In 1840 I was not living at Balhannah, but nearer Mount Barker township. As to his assertion that Mr Ridley stayed at my house and borrowed a book, I positively deny that Mr. Ridley was ever a guest of mine, or that I lent him a book. What Mr. Kelly says can have nothing to do with the reaping machine invention, as the date he mentions, 1840, is two years before the machine was even talked about. The Reaping Machine Committee met in September, 1843. Now, I have been very careful never to publish any statements which I could not prove. Let those who write against me do likewise, is all I ask. I desire at this stage that you publish the following letter, as the writer is dead.

To the Editor of the "Advertiser."

Sir,—As a number of letters have appeared in the papers as to who invented the stripper, I state that in the year 1843 I lived and carried on my business in Blyth Street. I may well remember all about the meeting at

Payne's Hotel in September, 1843, where a number of models were exhibited and that Mr. Bull and Mr. Marshall showed models. I afterwards made the comb and beaters for the machine which Mr. Marshall built for Mr. Bull. I had at the time some heavy mill work to make for Mr. Ridley, so I can remember all particulars. Mr. Bull should have the credit of the invention of a machine to thresh a standing crop, and for having given it for the benefit of the Colony.—I am, Sir, etc.,

(Sgd.) J. G. Coulls.

Athelstone, March 21, 1876.

Situated as I am I cannot undertake to answer such palpable and inaccurate letters as those of Messrs. H. Mildred and James Kelly, and shall only trouble you when any of my statements are called in question. I may have to refer to nearer neighbours than Mr. Kelly, viz. Mr. W. S. Whitington and Mr. W. Richardson.—I am, Sir, etc.,

(Sgd.) J. W. BULL."

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(77)

"Register," 20th May, 1886, page 7, col. 7.

Ridley's Reaping Machine.

To the Editor.

"What we want is facts" (vide "Gradegrind" in "Hard Times").

Sir, Non obstante,—Re J. R. Bull's letter in this morning's "Register" and his statement that I have unmanfully rushed into print and omitted to furnish dates and references. I trust that gentleman will pardon my temerity for appearing in print again and asserting that my letter is one of facts generally from a memory I can assure him I may even yet rely upon for what I wrote regarding Ridley's reaper. However, I shall be thankful to have it further refreshed if it is possible for Mr. Bull to answer the following queries—Will he be good enough to inform me when and where his machines were at work or to be seen (even in the course of construction)? When Ridley's were actually in operation at Unley on my visit of inspection? I don't know that I can find a diary extending back some forty-five years to give Mr. Bull the day and date, but I do most positively assert as a fact that I was a witness at Unley to the working of the Ridley stripper, and that I had never heard of Mr. Bull's or any other at the time being at work in the Colony.—I am, Sir, etc.,

HIRAM MILDRED.

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(78)

"Register," 26th May, 1886, page 3, column 8.

"Ridley's Reaping Machine.

Sir,—How unfortunate Mr. Mildred is, he begins his second attack on me by a quotation 'What we want is facts' but singularly enough he deals mainly in fictions. Like Baron Munchausen he imagines he sees giants and only runs amuck at a shadow. I thank him for giving me such an easy answer to be rendered. Why has he asked the unnecessary question as to the time I had my machine made? I never said I had a machine at work or in construction in the season 1843, when Mr. Ridley's first machine was in the field working. I must first ask Mr. Hiram Mildred to look at and read my answer to his first letter (which he cannot have read). There I quote from your paper of March 10th, 1845, praise to Mr. Ridley in bringing into action a machine constructed on my principles of comb and revolving beaters, etc., a model of which I had exhibited some three months before he had his first machine at work. Then he cannot have read a letter from Mr. Samuel Marshall, an extract from his letter to me, the letter in full in my recent answer to Mr. Ridley." (Mr. Marshall's letter) "'After I had tried my machine in November, 1843, I went to assist Mr. Ridley to build his first field reaper.'

Now I must refer Mr. Hiram Mildred to my book, 'Early Experiences of Colonial Life' (first edition, page 240), "harvest 1843-44"—'I had a fine crop of over 30 bushels an acre. A few standing crops were gathered by Mr. Ridley's first machine, the only one constructed that season. Mr. Ridley, after employing it on a few standing crops purchased by him, as well as some others near Adelaide, was kind enough to send a man with horses and his machine to me, and by means of this my crop was gathered.'

This appears at page 161 in my second edition, copies of which I know Mr. Mildred received as he was a liberal subscriber. I delivered the books and received payment —thus I wish to give due justice to him. He goes on to say, 'I most distinctly assert that I was a witness at Unley to the working of the Ridley stripper and that I had never heard of Mr. Bull's or any other at the time being at work in the Colony.' Dearame, how could he? I think I may add, nor as having heard any one say such a thing. So much for Mr. Mildred's facts.

But I must go back again to his visit to the wheat field at (near) Unley. Of course I take it he was there, and so was I, say the second day. I stood with delight to see it working so well with such an inconvenient arrangement of propulsion, the horses being rigged to a long pole behind the machine, the man behind them with one hand on the steering handle to steer by a small wheel, his other hand holding the reins. I was surprised to see how well he managed to drive this tricycle and allowed him to be about the most clever part of the concern. This propelling system, the pole to push the machine, of course, was taken from a book, as I know that such a plan was or had been in use in mowing machines in England. I think it was Bell's; but Mr. Ridley abandoned it in all other machines he had constructed subsequently. I am too much pleased to have so easily answered (by reference published so long ago) Mr. Mildred to be cross with him. He calls me "obstinate." I do not like calling names but I think I have proved him to be something more than inaccurate, as he has been too idle or careless to get his case up in favour of Mr. Ridley and against me to the injury of his client. But I pardon him as he asks it so politely.

I do hope the above will be sufficient to close the case with Mr. H. Mildred. I desire peace and quiet the short time I have to live. Kind and charitable Dr. Campbell is now attending me. Finally, I repeat I had no machine either made or in course of construction in 1843, and never claimed any credit or honour but as the inventor and exhibitor of a model comb and beaters in 1843, three months before Mr. Ridley brought out such a machine at the harvest of that year.—I am, Sir, etc.,

(Sgd.) J. W. BULL.

College Park, May 21st (1886)."

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(79)

"Register," May 26th, 1886, *page* 3, *col.* 8.

"To the Editor,

"Sir,—Being one of the pioneer farmers of the Colony, and conversant with all the early strivings and attempts of the first settlers to overcome the manifold difficulties of our then new settlement, I always take an interest in all letters and books which become public relating to those early times; and none have given more pleasure than the one on the above subject from our old and respected colonist Mr. John Ridley, showing forth with his own hand facts which establish his just claim as inventor of the machine known by his name, and for which we owe him a debt of deep gratitude at least. I am well aware of the fact that several other gentlemen, respected old colonists, spent both time and money in the endeavour to produce a reaper to replace the sickle or scythe, the only means then in use to gather in the harvest, 'and which were soon found would be a bar to farming profitably in this Colony, for reasons which are patent now as well" . . . (the following few words the type hasn't printed) "But of all the trials made I know of none that were successful but one, and that one was John Ridley's, and this I wish to testify to at the present time, if you allow me the space. Mr. Ridley has given you in his letter, nearly, if not in the same words, what he told me well-nigh forty years ago.

"He had called on me one day on business, and in conversation afterwards on the machine subject I remarked that I often wondered how he came to think of the plan of gathering by comb and beaters. His reply was to this effect: 'Well I may say that the comb part of it was not altogether mine. I saw a tracing and a description of a crude kind of machine taken from an old Roman work on a cutting principle—a man standing at side, and sweeping or raking the ears back into the box behind as they were cut. The idea then struck me that a comb after this sort, in combination with revolving beaters, might gather by threshing without cutting, and would be just the thing wanted to meet our case.' He then described, with the palm of his hand turned upwards, the form and working of the old machine, its mode of cutting the ears off, and the action of the man raking or sweeping them back, etc. This gave me an impression of its form and working which still remains, and which answers fully to the sketch at the bottom of his letter in your pages of the 6th instant.

"My remark was not that I doubted of his being the inventor. This I never did, having a general knowledge of what was doing at the time of the invention to quite satisfy me on that point. I merely wished to know how he came by his first idea, and he satisfied me as above; and I never had any reason to doubt his word, or to do so now. "The idea being obtained, he claimed construction of the new form of the comb, and to have devised its combination with the revolving beaters and all other parts, say: 1, the conformation of new comb, adapting it to the corn as it went, gathering it so that the revolving beaters could act on the ears above it and relieve the stubble on straw when threshed; 2, the adoption of the revolving beaters to the work of stripping off the grain; 3, the formation of the body to receive the grain; 4, the contriving of gearing for driving beaters, and for lowering and raising the comb, steering, etc. In bringing out these several parts he destroyed much material of iron and timber and castings. Heaps of each were to be seen in the mill yard for many years afterwards. I will here add that I never asked him or knew where he got the book or work he saw his old machine in, and I often thought it might have been one of Mr. Bull's, and that this might give rise to much of what has been said and written on this matter. But where the book came from or to whom it belonged has no bearing on the facts—John Ridley first constructed the reaper by what he saw therein."

"But, Sir, one of my objects in writing is to draw your attention to a circumstance which has, in so far as I have seen been overlooked, viz., that the committee of the Agricultural, Horticultural and Floricultural Society, after much discussion on the subject, in which I myself took part (the year I forget), resolved that a testimonial should be awarded to Mr. Ridley as the inventor of this machine, and for his princely gift of it to the Colony. The Committee, of which the late Hon. John Baker was then President, took means to find out what sort of testimonial, if any, would be acceptable to him, and they were given to understand that a written one would be preferable. Money was out of the question, in fact, so the Committee, of which I was then a member, voted him a testimonial engrossed on parchment or vellum; this, with others of the Committee, I saw and read, and it was posted to him, and I think replied to by him. Your files will testify to this."

"While this was being done no voice was raised that I recollect of saying it was undeserved; but, on the contrary, that it should be of a more substantial and national kind and form, equal to the gift. The Society considered by this testimonial that it had established to the world that the 'Stripper' was a South Australian invention, and that John Ridley was the inventor.

"Of course the machine, as left by Mr. Ridley, was far from its present state of perfection; and the Colony is indebted to many other old colonists for improvements thereon, chief amongst whom was the late Mr. James Adamson, who adopted rack and pinion for raising and lowering the comb at present in use, and, I think, several others.

"This letter would have been in your hands some days ago but for your footnote to Mr. Bull's letter, but since you have allowed further ones I am encouraged to hope you will accept my say in the matter also.—I am, Sir,

(Sgd.) JAS. UMPHERSTON.

The Caves, Mount Gambier, May 20, 1886."

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(80)

"Register," June 4th, 1886, *page* 3, *col.* 8.

The Ridley Reaper.

To the Editor.

Sir,—"I must ask the favour of a small portion of your valuable space to make a few remarks on Mr. Umpherston's long letter which appeared in a recent issue of your paper. I premise that I hold Mr. Umpherston in much respect. First, he starts his reminiscence from a conversation with Mr. John Ridley, at his (Mr. Umpherston's) residence. Mr. Ridley said (in reply to a question abbreviated) 'Well, I saw (in a book) a tracing and description of a crude machine' —the book again. Against this conversation, I set that contained in the late Mr. James Allen's letter, showing a very different source of information obtained which you published with my answer to Mr. Ridley. Mr. Allen's report referring to a date immediately after Mr. Ridley saw my working model (comb and beaters); the other conversation must have occurred when strippers were in full swing. This brings me to the first crucial point I have previously laid down, viz., What was the principle of Mr. Ridley's first machine, which he announced was nearly finished when he was present at the exhibition of models and plans? The wreck of that structure (never put to work) was

to be seen on the waste heap, referred to by Mr. Umpherston, information of which I received in writing from Mr. Wilkinson—whom I did not know—who was engineer to Mr. Ridley at the time of the exhibition of models, etc., I also had early information from persons visiting the yard. I was well aware of what large sums Mr. Ridley expended before he sent for the late Mr. Samuel Marshall to 'build' a machine (in November, 1843) which was identical with my exhibited model, and which after the meeting I left with Messrs. Hamilton and Henderson, and gave the same to the Colony. No. 2 crucial point. Did Mr. Ridley apply to Governor Grey for protection from home? As to subsequent improvements Mr. Umpherston gives from memory (not affecting me)—I like to correct—'the rising and lowering the comb,' was by Mr. J. Adamson, whereas it was Mr. John Godlee and the facility of adjusting the beaters was by Adamson. Mr. Umpherston further says 'The contriving of gearing, etc., for driving the beaters' was the work of Mr. Ridley, whereas it was Mr. Bagshaw, sen., who designed such works and made the patterns from which they were cast. I think if Mr. Umpherston had been present at the reaping machine (especially as one of the committee) with his clear head and knowledge of mechanics he would have asked Mr. Ridley the principle of his "nearly finished" implement, or would have gone subsequently to see for himself, and then my first crucial question would not have been put. On this subject I state positively before the meeting that he was having constructed a most complicated implement to cut the straw, pass it through a thresher and drop it as it went, also a fixed threshing machine to be driven by his mill engine. Finally there is a fact in Mr. Ridley's career which under the circumstances in which he and his friends have placed, I am entitled to put forth. Mr. Ridley, by the aid of the stripper, quickly made a fortune and became an absentee, enjoying his riches in England, drawing from poor South Australia what he had realised. For myself I would say a word in conclusion. After from time to time giving hours of thought, personal exertions in the field, some time last year I gathered from such experience that by simple arrangements, no movement, the chaff would be separated from the wheat retained in the machine and the white heads to be passed through a threshing and bagging blower. Messrs. Mellor Bros. agreed to expend £50 on the work, which they liberally exceeded with a promise to give the arrangements a fair trial, the failure of crops or cutting for hay near Adelaide prevented a trial. Thus I was compelled to abandon the whole to that firm, requesting them to bring the arrangements out next harvest, and to my misfortune I lost a small sum I was to have received if it had proved a success. I must remark this is not an advertisement as the improvements are thrown open to the public.—I am, Sir, etc.,

(Sgd.) J. W. BULL.

College Park, 1st June, 1886.

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(81)

"Register," 19th June, 1886, page 7, col. 7.

To the Editor.

Sir,—I ask you as a favour to allow me room for one letter to assist my poor old father against letters that have appeared in your paper for the purpose of giving the honour of inventing the stripper to Mr. Ridley, who, I can easily prove, did not invent one idea in the stripper. If Mr. Ridley and his supporters will put in your hands a sufficient sum of money I will give my share, if it takes the last farthing I have, to pay for a committee of gentlemen to take evidence so as to be able to give a decision as to who was the first to make public a working model of a machine with comb and revolving beaters, driven by a chain belt which ran on wooden cogs fixed to the side of the carriage wheel and round a cog wheel attached to the fly wheel, this fly wheel carrying the leather belt and working the pinion which drove the beaters. This machine had a wooden screw to raise and lower the comb. I write on facts as I helped my father in the harvest of 1842 and 1843 in the construction of his first rough model. When it was finished, he tried it by tying some of the ripe corn to a long stick which I and my brother Robert held across a long table. My father ran his machine through the corn which stood upon the table the same as in the field. The beaters cut off the ears and drove the corn up an inclined slide into the back of the box well threshed. My father's word were, 'I have now proved to my satisfaction that if I can get a good tradesman to build me a machine I can harvest a crop of wheat without the humbug and expense of hand labour.' He did not make a secret of his invention, but told most of his neighbours who laughed at what he was trying to explain to them. The names of some of

those gentlemen were:—W. S. Whitington, Rober Cock, Allan McFarlane, Osmond Gilles, W. Richardson and a number of others I could mention. I remember my mother saying to my father, more than once, 'What a fool you are to tell everyone; some person will get hold of your ideas and build a machine,' to which my father replied, 'I don't care who uses it—I freely give it to the public; I only want to see it brought into practical use.'

Now, for your information and those who have rushed into print without being careful to ascertain the correct dates of all these incidents and what actually occurred, and as their letters of fiction might induce some people to believe them, I may state that my father found out his idea in December, 1842. I was with him when he went into the crop to show one of the men how ripe the crop was. He thrust his fingers into the ears and struck them with the other hand. I saw that an idea had struck him by his ordering the men to cut a sheaf of wheat, which he took to the barn and hit with a piece of wood. He said—'I have found out how to thresh a standing crop of wheat.' This was, of course, previous to making the model above referred to. The next year (1843) the Corn Exchange Committee advertised a reward for the best invention, to be shown in September of that year, so as to allow time for the construction of machines before the coming harvest. This, you see, was nearly one year after my father found out his idea. He took his model down to my uncle's at Netley to get a neater one made for the competition. I was there on a visit and saw my uncle making in his carpenter's shop the machine that my father showed at the meeting in September, 1843. I will never forget the circumstance, as I was playing one day with one of my uncle's chisels and drove it into my wrist and can show the scar to this day. You will see by your back files that my father could not make the Committee, although Mr. Ridley was with them, believe that his invention would answer. It seemed so strange that Mr. Ridley, 3 or 4 months afterwards, should bring into the field a machine with comb and beaters and not to have said at the meeting that he had one building on those principles. He simply said that his machine would be ready the following Monday; it might have been a grubbing machine, for no stripper of his was ever made public until Mr. Marshall built his first stripping machine for him. (See Mr. Marshall's letter to Mr. Bull.) The Editor and Proprietor of your paper at that time says he took that report himself, so it can be relied on. Mr. Ridley was present and saw my father's model, and he is the wrong sort of man not to have said, 'I am constructing a machiine on these principles.' Now, I have heard Mr. Marshall say as well as others that they went to Mr. Ridley's shop to see the machine he referred to and it was simply a common mowing machine to cut the straw. Mr. Ridley saw that Mr. Marshall's mowing machine, showed at that meeting, was a better idea than his, and offered to go halves with him. You will see by Mr. Marshall's letter to Mr. Bull that he went about two months after the exhibition of the models to build Mr. Ridley's first stripper.

How does that tally with Mr. Ridley's letter, in your journal of May 6th, and in which he says he has hitherto kept a silent and dignified course? Now I think it has been a most cunning and unjust course to wait until all the gentlemen that were eye witnesses to the meeting in 1843 and those who helped to build these machines were dead, before contradicting Mr. Bull's claim. You might say he has been lying on his oars silently for forty-two years. The ridiculous drawing from 'Loudon's Encyclopaedia,' claiming to be a machine, is more like a dung cart of very common make, and not one part of it is anything like any part of the stripper. But, Sir, supposing Mr. Ridley shut his eyes to every other person's inventions and that the whole of the principles in his first stripper that came into public notice were his own, he cannot claim to be the first, as it is proved by your back files that my father was the first who made those principles public. I would remind Messrs. Mildred, Kelley and Umpherston that Mr. Bull (if he is on his last legs) has sons who were eye-witnesses of all that was going on, and who have good memories and too much pluck to allow anyone to write fictions about this subject without contradicting them. These persons could not have been readers of your journal at that time or they would be more careful and correct as to what they are stating. I would remind Mr. Umpherston that Mr. Ridley had no castings in his first machine, as there were no means of making them at that time—the year 1843. I would also call your and those gentlemen's attention to the decision come to by three respectable gentlemen in Adelaide several years ago. Their decision after going through all the evidence was that they had not the slightest doubt that Mr. J. W. Bull was the inventor of the stripper. The gentlemen I would name to form a committee of Inquiry, if Mr. Ridley and his friends are anxious to investigate this affair, are Sir Thomas Elder, Hon. John Ramsay, Hon. John Dunn, Mr. E. T. Smith, M.P., Mr. John Dounsevell, and Mr. Goyder (Surveyor General). I think you will agree with me that these gentlemen would give an impartial award if they would act. Neither my father nor any of his family ever tried to rob Mr. Ridley of the merit due to him in bringing

my father's invention into practical use, but the machine ought never to have been called the Ridley Stripper.

Mr. Ridley and his friends ought to have contradicted my father's letters years ago and not have waited until the eye-witnesses were dead.

Sir, it was only by chance that those letters were sent to me as I live away in the bush, so you must excuse me for not writing before. I only wish honour to whom honour is due and I think the public and yourself will agree with me on that point.—I am, Sir, etc.,

(Sgd.) JOHN BOWYER BULL.

Wallup, Victoria, 10th June.

(82)

"Register," 22nd June, 1886, page 7, col. 3.

The Inventor of the Stripper.

Sir,—Mr. J. W. Bull is under a mistake in supposing all parties present at the exhibition of appliances for reaping the crops held in September 1843 are dead. I was present and am still living.

I can positively state that there was exhibited by Mr. J. W. Bull a model machine with a gathering comb and revolving beaters, and it was the only one exhibited.

I cannot charge my memory as to the presence of Mr. Ridley on that occasion, but since both Mr. Bull and his son assert that he was present, no doubt he was so, and must have noticed the principle of Mr. Bull's machine. From that time until the present day I have been fully convinced that Mr. Bull was the original inventor and Mr. Ridley the man who brought it into practical operation.

(Sgd.) FRANCIS DUFFIELD.

Clare, 21st June, 1886.

COPPER DEFICIENCY—THE CAUSE OF ENZOOTIC ATAXIA ("RICKETS") OF LAMBS.

H. W. Bennetts, D.V.Sc., Veterinary Pathologist.

The purpose of this article is to summarise the results of recently carried out experiments and chemical work which has demonstrated that enzootic ataxia of lambs is due primarily to copper deficiency, and to give some suggestions regarding prevention. A detailed account of the investigation is published elsewhere, Bennetts & Chapman (2).

The disease has been described previously in this Journal, Bennetts (1), but a further statement of the salient features will not be out of place here.

1. *The Disease.*

Enzootic ataxia, popularly known as "rickets," although in no way related to true rickets or zamia poisoning, which locally receives the same popular designation, occurs in the Gingin and Dandarragan districts and in other coastal areas of this State. Apparently identical diseases, known under various names, "swayback," "renguera," etc., occur in Great Britain, Peru, Sweden and other Australian States.

Under our conditions the disease affects, chiefly, the progeny of ewes depastured continuously on "affected" country for more than one breeding season. Under such conditions up to 100 per cent. of the lambs develop ataxia. To

prevent the disease it is customary, on affected properties, to purchase fresh breeding stock each season or to move in-lamb ewes to sound country during the summer months, such procedures having been found to be effective in preventing any serious incidence, although they do not assure optimum growth and development.

Symptoms.—Under particularly unfavourable circumstances lambs may be born dead or die within a few days of birth after showing signs of brain trouble. Generally, however, the disease is not obvious till lambs are a few weeks old. The onset is marked by a check in growth and loss of condition. This is followed by the appearance of a characteristic inco-ordination of gait affecting the hind legs—the animal having no proper control over its movements. This ataxia is accentuated by driving, the hindquarters sway sideways and the animal falls over. Rest is followed by a temporary improvement, but symptoms soon reappear with further driving, and the animal becomes greatly distressed and is rapidly fatigued. Over a period of days or weeks the symptoms become progressively worse and the animal dies from poverty, anaemia and intercurrent infections. Lambs which do not become affected until three months old show a more chronic non-fatal type of disease. They may grow fairly well and ultimately show some improvement, although an abnormality in gait persists.

The very early fatal type of the disease is a sequel to brain degeneration which may be very extensive. The typical symptoms of ataxia, however, result from a characteristic degeneration of the spinal cord. There are no typical naked eye appearances in lambs dying from the disease.

2. *The Cause.*

As already indicated, Bennetts (1), it was suspected that lead poisoning was probably responsible and the use of a "de-leading" agent, ammonium chloride, administered to in-lamb ewes gave very promising results. Subsequently, however, this treatment gave irregular results, and it was decided to investigate the possibility of the disease being due to a deficiency in one of the "minor elements." Thanks to the courtesy of Dr. E. S. Simpson (Government Mineralogist and Analyst), arrangements were made for Mr. F. E. Chapman, of the Government Chemical Laboratory, to carry out the required chemical investigation. In 1936 he examined, spectrographically, livers of affected and normal lambs and found that the only marked difference in mineral content was in the amount of copper present. There was a very marked deficiency of copper in the livers of affected lambs. A series of lead determinations on body tissues also showed definitely that that element was not a causal factor.

Experiments carried out during this season at Gingin have shown that a small supplement of copper sulphate (bluestone) given daily to second season ewes for 10 weeks during the in-lamb period prevented the incidence of the disease in the progeny, although lambs born from similar ewes (controls) which received no copper treatment were all affected with the disease when a few days old—many died at birth. Further the control ewes developed a severe anaemia in the late in-lamb period, whereas those ewes which had received copper were comparatively normal in this respect and were generally in better health and condition. (Subsequent work has indicated that the copper supplement should be administered throughout the in-lamb and nursing periods. The supplement referred to consisted of a daily drench of two ounces of a 0.1 per cent. solution of pure copper sulphate, viz., each ewe received 15 mgm. of Cu daily.)

It has been found, too, that the daily administration of a small amount of copper sulphate solution (7.5 mgm. of Cu) arrests the further progress of the disease in affected lambs, although retained on their anaemic mothers. Any ataxic gait, initially present, remains, but instead of a progression of symptoms to death, normal growth and development are speedily initiated and are maintained. Obviously copper treatment would be without effect in those early rapidly progressive cases in which the brain is degenerated at birth.

Ewes suffering with severe anaemia (e.g., Hb., 3.7 mgm. per 100 ml. blood, R.B.C. 3.1 million) and treated daily with small doses of copper (15-30 mgm.) showed an immediate response. As early as fourteen days after commencement the habitual open look of the fleece resulting from "stringy wool" was lost and treated sheep could be picked out in the paddock from non-treated anaemic ones. They appeared strong, "bloomy," bright and were in "killable" condition. It has been noted for many years that stock, in the "affected" areas, do not do well during the months of June, July and August. Sheep appear ragged, fleeces are "stringy," and scouring is unusually marked. During late June and July salt licks containing 0.5 per cent. copper sulphate were put out to several flocks of ewes and lambs in the Gingin district where salt is readily consumed throughout the year. A marked improvement in appearance was noted in the course of two to three weeks; scouring ceased, the fleeces had a more compact appearance and the sheep generally looked stronger and more healthy.

The results of these experiments indicate then that copper will prevent and cure the anaemia of the mothers and the ataxia of the progeny and will beneficially affect the general health and condition of both, thus suggesting that the troubles referred to are due to copper deficiency. That this is so is amply confirmed by chemical evidence. A large number of chemical determinations carried out by Mr. Chapman have shown that the livers, blood and milk of anaemic ewes and the livers of ataxic lambs are grossly deficient in copper as compared with those of normal animals. It might be mentioned, perhaps, that the copper content of livers varied from 120-360 parts per million in healthy animals, whereas in affected ewes and lambs copper was present in only 3-8 parts per million.

The whole story has not yet been worked out, but it is obvious that breeding ewes continuously depasturing on "affected" country are not in a position to supply adequate copper for the proper development and subsequent nursing of the progeny, although depleting their stores to such an extent that the resultant anaemia reached a dangerous level. (It has been known for some time that the presence of small amounts of copper is necessary for the growth of the young animal and for blood formation.)

Apparently a change to "sound" country for some two months during the in-lamb period generally, but not invariably, permits of the storage of sufficient copper by the mother for the normal growth of the embryo and for rearing the young lamb. Ewes recently introduced from "sound" country apparently have adequate copper reserves for the same purpose, but if lambing occurs too long (say seven to eight months) after change to the "affected" country the progeny may become ataxic. The mechanism of the copper starvation which occurs on the "affected" area is not yet fully understood. It is possible that the soil and consequently the pastures may be deficient in copper. On the other hand, it is possible that the soil contains adequate copper but that some factor or factors at present unknown interfere with the assimilation and utilization of this element by plant or animal.

This phase is being investigated.

3. *Suggestions Regarding Prevention and Treatment.*

Pending the results of further investigations now projected, it is not yet possible to make definite recommendations for the control of the disease. There are definite indications, however, that the consumption of a lick composed of salt 200 lbs., bluestone 1 lb. should beneficially affect the health and wool growth of lambing ewes (and other sheep) and should promote normal development and growth in the progeny. Field observations indicate that the lick should be available to the stock at least from mating to weaning time.

It is proposed to investigate the effects of top-dressing the pasture with copper compounds and of administering copper in drinking water to in-lamb ewes (1 ounce bluestone to 2,000 gallons of water). Preliminary experiments have indicated that the progress of the disease in affected lambs can be arrested by drenching regularly with small doses of copper. For this purpose a daily dose of ½ ounce of a solution containing 1 ounce of bluestone to 3 gallons of water is suggested.

Note.—It appears probable that "rickets" of foals and calves which occur on the same properties as enzootic ataxia of lambs, although the manifestations are different, may also be due to copper deficiency and respond to supplementary feeding with copper. This is being investigated.

4. *Summary.*

Enzootic ataxia is due, primarily, to copper deficiency. Lambing ewes depastured continuously on "affected" country are unable to provide adequate copper for the proper development of the progeny, although depleting their stores to such an extent that they become seriously anaemic.

The copper content of the liver, blood and milk of the mothers is very considerably below that of normal ewes. The copper content of the liver of ataxic lambs is of the same order and considerably below that of normal lambs. A small regular supplement of copper (given as copper sulphate) has a marked beneficial effect upon the health of lambing ewes, both prevents and cures anaemia of the mothers, and promotes normal growth and development of the progeny.

The investigation of the disease is not yet complete and it is, therefore, impossible at this stage to make definite recommendations for its control. Some suggestions, however, have been made which may prove helpful in the meantime.

5. *Acknowledgments.*

The writer desires to acknowledge his indebtedness to Mr. F. E. Chapman of the Government Chemical Laboratory, Perth, for the chemical work which is only briefly referred to in this paper.

Special thanks are due to Mr. F. A. Wedge, of Gingin, who, for some years now, has considerably assisted this investigation by placing the estate property and flock at our disposal for experimental purposes, and who has personally carried out much of the experimental detail.

6. *Bibliography.*

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THE OFFICIAL AUSTRALIAN PURE BRED DAIRY CATTLE PRODUCTION RECORDING SCHEME, 1936-37.

G. K. BARON-HAY, Superintendent of Dairying,
and
G. SLATER.

During the twelve months ended 30th June, 1937, 319 cows completed their tests under the Official Recording Scheme, the results being shown in Table 3. The number completing the full period of 273 days, however, was 236, or 74 per cent. of the total, while those completing 150 days or more numbered 292 or 91 per cent. As it is reasonable to assume that no pure bred cow, properly attended, would dry off in less than 150 days, the balance of 27 cows which were tested less than five times, and doubtless withdrawn from test owing to sickness or sale, have been omitted from Tables 1 and 2.

Table 1.

Breed.	Number of Cows tested.	Number of Cows passing Standard.	% Cows passing Standard.
A.I. Shorthorn	150	97	64.7
Guernsey	57	44	77.2
Jersey	85	45	52.9
Total	292	186	63.7

The average production of all cows irrespective of age was 300.87 lbs. butter fat, as against 297.17 lbs. last year, which in view of the dry season experienced is most satisfactory.

Table 2.

Class	A.I. Shorthorn. No. Cows.	A.I. Shorthorn. Av. Butter Fat.	Guernsey. No. Cows.	Guernsey. Av. Butter Fat.	Jersey. No. Cows.	Jersey. Av. Butter Fat.	All Breeds. No. Cows.	All Breeds. Av. Butter Fat.
Mature ..	27	378.61	17	370.04	30	320.25	74	352.98
Senior 4 Years ..	6	279.77	5	361 22	5	308.31	16	314.14
Junior 4 Years ..	14	312.03	5	379.87	10	299.64	29	319.45
Senior 3 Years ..	12	323.83	2	342.50	9	277.56	23	307.35
Junior 3 Years ..	22	288.30	10	311.09	9	267.64	41	289.32
Senior 2 Years ..	22	266.13	4	294.48	9	269.74	35	270.30
Junior 2 Years ..	47	260.66	14	251.31	13	252.56	74	257.47

The Wooroloo Sanatorium Farm's Australian Illawarra Shorthorn bull "Triumph of Pine Creek," 2515, was again Champion Herd Sire, with 12 daughters passing their respective standards for an average production of 335.28 lbs. butter fat. These cows included four Junior 2 year olds, two Junior 3 year olds, one Senior 3, two Senior 4 year olds, and three Mature cows.

Four records were created during the year, viz., "Leylands Melba" (418.43 lbs. butter fat) and "Leylands Topsy" (465.69 lbs. butter fat), owned by Messrs. D. Bevan & Sons, secured the Junior 2 All Breeds and Senior 2 A.I.S. Breed records respectively; "Yallah Farm Maggie II." (677.21 lbs. butter fat), owned by Mr. W. G. Burges, the Mature A.I.S. Breed record, and "Spring Park Starbright's Queen" (659.16 lbs. butter fat), owned by Messrs. Robinson Bros., the W.A. Bred Mature Jersey record.

TABLE 3.

THE OFFICIAL AUSTRALIAN PURE BRED DAIRY CATTLE PRODUCTION RECORDING SCHEME

Cows which completed Test from 1st July, 1936, to 30th June, 1937

Name of Cow	Breed.	Herd Book No.	Date of Birth.	Date of Calving.	No. of Days in Test.	Weight of Milk last day of Test.	Weight of Milk for period.	Average Test.	Weight of Butter fat for period.	Owner.	Sire
						lb.	lb.	%	lb.		
COWS UNDER 2½ YEARS OLD BUTTERFAT STANDARD 230 LBS.											
Leylands Melba	A.I.S.	17170	1-9-33	1-12-35	273	32	9,436	4·41	418·43	D. Bevan & Sons	Widzee Wee Record (348)
Travalgan Lady Mint 4th	Jersey	65867	11-9-34	3-5-36	273	19	6,072	5·48	363·42	Robinson Bros.	Banyule Altitude (5793)
Tipperary Beauty II.	A.I.S.	18314	8-4-34	30-6-36	273	20	8,175	4·16	339·38	W. G. Burges	Blacklands Commander
Glanavon Sunbeam V.	do.	16493	6-10-33	24-3-36	273	31	8,133	3·98	335·93	D. Bevan & Sons	Tipperary Peter Pan (962)
Greenmount Golden Dewdrop	Jersey	...	7-8-34	11-10-36	273	19·5	6,284	5·36	333·09	A. J. B. Strempel	Bellefaire Bonaparte's Bonetienne (9224)
Woorooloo Rose III.	A.I.S.	15344	27-11-33	4-1-36	273	26	7,006	4·72	330·82	Woorooloo Sanatorium Farm	Triumph of Pine Creek (2515)
Greenmount Sweet Lass	Jersey	44201	14-7-33	5-11-35	273	16·5	5,915	5·61	327·88	A. J. B. Strempel	Bellefaire Bonaparte's Bonetienne (9224)
Claremont Maggie Morrison 14th	A.I.S.	15065	4-9-33	25-11-35	273	19·5	8,406	3·86	324·45	Claremont Hospital for Insane	Claremont Herdsman (968)
Greenmount Joyful Maid	Jersey	53052	13-3-34	28-1-36	273	19	5,652	5·70	322·31	A. J. B. Strempel	Bellefaire Bonaparte's Bonetienne (9224)
Woorooloo Milkmaid V.	A.I.S.	16339	2-1-34	10-2-36	273	25	8,505	3·77	320·64	E. T. Thatcher	Parkview Guardian (2557)
Tipperary Dove	do.	18320	21-1-34	6-7-36	273	19	7,812	4·09	319·70	W. G. Burges	Blacklands Commander (2015)
Glanavon Daphne	do.	10022	7-8-33	15-12-35	273	25	7,405	4·29	317·57	D. Bevan & Sons	Villiers of Barbabara (2386)
Claremont Star 12th	do.	9947	3-9-33	31-10-35	273	22·5	6,863	4·56	312·82	Claremont Hospital for Insane	Tipperary Daphne's Boy (449)
Greenmount Little Dot	Jersey	...	20-1-34	28-8-36	273	18	5,994	5·12	308·54	A. J. B. Strempel	Bellefaire Bonaparte's Bonetienne (9224)
Brookfields Glory	Guernsey	4059	15-3-31	16-5-36	253	20	6,135	4·79	308·24	P. G. Hampshire	Koojan Ace's Chancellor (2274)
Claremont Hilda 4th	A.I.S.	15063	23-12-33	24-4-36	273	23	7,224	4·23	306·22	Claremont Hospital for Insane	Tipperary Daphne's Boy (449)
Woorooloo Joy	do.	15333	10-1-34	2-8-36	273	15	7,050	4·32	304·74	Woorooloo Sanatorium Farm	Parkview Guardian (2557)
Brookfields Lady Hope	Guernsey	5326	11-9-34	24-6-36	273	17·5	6,008	5·08	302·92	P. G. Hampshire	Koonon Lord Barkly (1031)
Woorooloo Dove II.	A.I.S.	15323	6-5-34	2-8-36	273	23	7,194	4·08	301·06	Woorooloo Sanatorium Farm	Parkview Guardian (2557)
Claremont Duchess II.	do.	9920	17-10-33	19-12-35	273	24·5	6,911	4·32	299·09	Claremont Hospital for Insane	Tipperary Virginia's Reecho (970)
Woorooloo Matilda II.	do.	15337	22-5-34	1-8-36	273	21·5	6,785	4·34	294·35	Woorooloo Sanatorium Farm	Triumph of Pine Creek (2515)
Selsey Ranunculus	Jersey	55209	13-8-34	5-8-36	240	17	5,445	5·32	289·98	Robinson Bros.	Brampton Great Boy (imp.) (9137)
Tipperary Snowdrop 5th	A.I.S.	14787	29-4-33	31-5-36	273	19	7,640	3·77	288·34	A. E. Grant	Tipperary Victor's Re-echo (1337)
Woorooloo Kitty II.	do.	15334	23-8-33	25-11-35	273	23·5	6,956	4·10	285·38	Woorooloo Sanatorium Farm	Triumph of Pine Creek (2515)
Newstead Lovely 20th	do.	17685	19-2-34	26-2-36	273	18	7,164	3·95	283·3	W. G. Burges	Renown of Newstead (3077)
Claremont Rachel 9th	do.	15972	9-11-33	30-3-36	273	22·5	6,963	4·06	282·37	Claremont Hospital for Insane	Tipperary Virginia's Reecho (970)

Brookfields Bonnie Blossom	Guernsey	5319	15–9–34	16 9–36	273	20	5,310	5·31	281·76	P. G. Hampshire .	Koojan Lord Barklay (1031)
Selsey Wyandotte III.	Jersey ..	55215	14–8–34	16–7–36	273	9	3,927	7·17	281·56	Robinson Bros. ..	Brampton Great Boy (imp.) (9137)
Koojan Ace's Algra	Guernsey	4331	22 9 33	18–11–35	273	16·5	4,910	5·66	278·17	A. W. Padbury	Homestead Ace (imp) (1631)
Claremont Clara 7th	A.I.S. ...	15957	1 4 34	19–7–36	273	20	6,600	4·06	268·25	Claremont Hospital for Insane	Tipperary Virginia's Re-Echo (970)
Muresk Damsel	Guernsey	4720	2 11 33	11–7–36	240	5·5	5,483	4·91	268·04	Muresk Agricultural College	Muresk Homestead (2075)
Westby Primrose	A.I.S. ..	18520	7–9–34	6–10–36	273	23	6,909	3·82	264·28	Bayley Bros. . .	Telyarup Duke (956)
Westby Polly II.	do.	15142	1–12 33	30–3–36	273	16	6,807	3·86	262·68	Bayley Bros.	Telyarup Duke (956)
Claremont Maggie Morrison 15th	do. ...	15966	15–11–33	20–4–36	273	17	6,171	4·20	259·44	Claremont Hospital for Insane	Tipperary Virginia's Re-Echo (970)
Claremont Whitby Maid 17th ...	do.	9951	1–10 33	24–12 35	273	16	6,603	3·87	256·60	Claremont Hospital for Insane	Tipperary Daphne's Boy (449)
Claremont Lucy 7th	do.	15964	2–5–34	9–8–36	273	18	6,639	3·9	255·18	Claremont Hospital for Insane	Claremont Herdsman (968)
Wooroloo Duchess 3rd	do.	15325	6–11–33	1–2–36	273	22	6,066	4·20	254·98	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515) (A.R. A.M.S.)
Glanavon Sunbeam IV. .	do.	16492	28–9 33	16–3–36	273	12	5,766	4·38	252·84	D. Bevan & Sons ...	Tipperary Peter Pan (962)
Tipperary Victress	do.	14790	8–7 34	19–6–36	273	19·5	6,472	3·89	251·74	A. E. Grant	Parkview Rosy's Monarch (1681)
Claremont Biddy 26th	do.	15949	27–11 33	14–4–36	273	15	6,090	4·07	247·79	Claremont Hospital for Insane	Tipperary Virginia's Re-Echo (970)
Claremont Cherry 7th	do.	9915	25 10 33	21 11 35	273	14	5,262	4·63	243·93	Claremont Hospital for Insane	Tipperary Virginia's Re-Echo (970)
Claremont Biddy 25th	do.	9910	14–10–33	14 1–36	273	15·5	5,717	4 24	242·55	Claremont Hospital for Insane	Tipperary Virginia's Re-Echo (970)
Glanavon Anne II.	do. .	10919	8 9 33	1 3 36	273	21	5,433	4·45	242·00	D. Bevan & Sons	Glanavon Nimrod (437)
Glanavon Ramona .	do.	16490	3 2 34	1 3 36	273	17	5,391	4 48	241·42	D. Bevan & Sons	Villiers of Darbalara (2386)
Lansdowne Diana . ..	Guernsey	4358	2 5 34	28–7–36	273	14	5,112	4·71	240·76	J. R. Giles	Koojan Ace's Advocate (2272)
Brookfields Golden Queen .	do.	4060	5–1–34	22–3 36	273	16·5	5,150	4·66	239·98	P. G. Hampshire	Koojan Lord Barklay (1031)
Lansdowne Dairy Miss II.	do. .	4356	14 1 34	10–5–36	273	13	4,239	5 62	238·33	J. R. Giles	Koojan Ace's Advocate (2272)
Denmark Dawn	do. ..	4117	6–3 34	29–7–36	273	8·5	4,503	5·25	236·38	Denmark Research Station	Koojan Golden Prosper (2283)
Lansdowne Joyce	do. ..	4361	17 3 34	25 11 35	{ 365	18	6,765	4·77	322·46 }	J. R. Giles	Koojan Ace's Advocate (2272)
					{ 273	18	5,169	4·56	235·67 }		
Iginup Ellen	A.I.S.	16922	31 7 33	13–10–35	240	12	6,195	3·80	235·11	E. C. Melville	Tipperary Melba's Emblem II. (989)
Claremont Blossom 13th ..	do.	9913	22 9 33	8 11 35	240	20·5	6,045	3 84	232·35	Claremont Hospital for Insane	Tipperary Daphne's Boy (449)
Claremont Blossom 14th .	do.	15950	8 8 34	22 9 36	273	17	5,451	4·24	231·24	Claremont Hospital for Insane	Tipperary Virginia's Re-Echo (970)
Lansdowne Dorothy	Guernsey	5682	9 8 34	27–7–36	273	16	4,248	5 44	230·96	J. R. Giles .	Koojan Ace's Advocate (227 2)
Lansdowne Dorothy II.	do. .	4359	27 7 33	1–12–35	{ 365	17	6,415	4·89	313·51 }	J. R. Giles	Koojan Ace's Advocate (2272)
					{ 273	21	4,833	4·76	230 06 }		
Claremont Lily 5th ...	A.I.S. ..	9926	13 10 33	7 12 35	273	16	5,778	3 96	229·28	Claremont Hospital for Insane	Tipperary Daphne's Boy (449)
Wooroloo Rosella II.	do.	15346	2 11 33	26 12 35	273	12	4,806	4·74	227·85	Wooroloo Sanatorium Farm	Tipperary Persimmon (471)
Grass Vale Twylish Maggie .	Jersey .	53029	12–6 33	10 12 35	273	11	4,653	4·82	224·38	R. H. Rose	Banyale Silvermine Twylish (7600)
Claremont Belle 13th . .	A.I.S. .	9905	18–10–33	25 12 35	273	10·5	5,222	4·28	223·82	Claremont Hospital for Insane	Claremont Herdsman (968)
Muresk Bessie . . .	Guernsey	6048	4 7 34	19 8 36	273	13	4,074	5·41	220·57	Muresk Agricultural College	Wollongbar Triumph (513)
Crantock Golden Cream .	Jersey .	52397	27 6 34	10 4–36	240	13·5	3,773	5 82	219·58	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Yanget Della II.	A.I.S.	15409	3–5–34	1–4–36	273	18·5	5,411	4·01	216·87	A. E. Grant	Sunrise of Parkview (1875)

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Calving.	No. of Days in Test.	Weight of Milk last day of Test.	Weight of Milk for period.	Average Test.	Weight of Butter-fat for period.	Owner.	Sire.
COWS UNDER 2½ YEARS OLD—STANDARD 230 LBS. BUTTER-FAT.											
						lb.	lb.	%	lb.		
Lansdowne Golden Hope III.	Guernsey	5684	7-8-34	31 7 36	273	14	4,512	4·58	206·49	J. R. Giles	Koojan Ace's Advocate (2272)
Wooroloo Poppy	A.I.S.	15341	28-3-34	25-1 36	210	19·5	4,770	4·30	205·02	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Claremont Maggie 6th	do.	9933	8 9-33	12 11 35	273	9	5,182	3·88	200·96	Claremont Hospital for Insane	Claremont Herdsman (968)
Wooroloo Betty IV.	do.	15321	3 1-34	2 6 36	240	10·5	4,575	4·20	192·42	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515) A.R. A.M.S.
Wooroloo Freda	do.	15330	7-8 33	29 11-35	240	12·5	4,980	3·81	190·29	Wooroloo Sanatorium Farm	Wooroloo Prince (2974)
Leylands Champagne's Lovely	do.	12249	5 6 34	2-5-36	273	15	4,838	3·85	186·43	A. E. Grant	Thornleigh Champagne (930)
Colmyn Vera	Jersey	47680	29 9-33	19-10 35	240	11·5	3,630	4·86	176·70	C. H. Ironmonger	Rye Duke of Glen Iris (1994)
Ilginup Ena	A.I.S.	16923	15-1-33	20-10-35	240	7	4,560	3·83	174·87	E. C. Melville	Tipperary Melba's Emblem II. (989)
Wooroloo Eva II.	do.	15327	27-8 33	13 11-35	240	11	4,515	3·77	170·37	Wooroloo Sanatorium Farm	Wooroloo Prince (2974)
The Wold Northwood Pride	Jersey	50863	5 5-34	5-5-36	240	6	2,655	5·55	147·33	L. C. Field	Lonswood Lord Grey (7291)
Sabina Vale Lady	do.		6 5-34	15-6-36	273	9·5	3,449	4·19	144·45	Sabina Vale Stud Farm	Banyule Ettric (9200)
Sabina Vale Princess	do.		9-9-34	9-6 36	273	6	2,463	5·85	144·10	Sabina Vale Stud Farm	Banyule Ettric (9200)
Wooroloo Sweet Nell	A.I.S.	15349	5 12 33	1-2-36	180	16	3,450	3·67	126·78	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Tipperary Polly II.	do.	18333	4 11-34	14-8-36	120	18·5	2,220	4·05	89·88	W. G. Burges	Parkview Rosy's Monarch (1681)
Glanavon Elaine	do.	16487	27 12-33	9-3-36	120	20	2,310	3·85	88·98	D. Bevan & Sons	Glanavon Valiant (438)
Wooregong Pet II.	do.	18624	4 7-34	15-9 36	90	21	1,920	4·39	84·24	W. G. Burges	Tipperary Twilight IV. (1680)
Selsey Attraction	Jersey	55203	16-7-34	30 7-36	60	23	1,395	5·69	79·20	Robinson Bros.	Brampton Great Boy (imp.) (9137)
Grantham Starbright's Carnation II.	do.	48533	30-10-33	20-3 36	90	18	1,470	5·4	79·17	J. A. Sears	Greenmount Black Prince (6511)
Wooregong Hope	A.I.S.	18622	4 8 34	13-9-36	90	17	1,740	4·15	72·30	W. G. Burges	Tipperary Twilight IV. (1680)
Claremont Whitby Maid 20th	do.	15979	23 3 34	19-8-36	60	25	1,455	3·91	56·79	Claremont Hospital for Insane	Tipperary Virginia's Re-Echo (970)
Claremont Stella 7th	...	15974	15-3-34	20 7 36	60	22·5	1,350	3·98	53·28	Claremont Hospital for Insane	Tipperary Daphne's Boy (449)
Claremont Mavis 4th	do.	15968	7-5-34	26-8-36	60	21·5	1,290	3·70	47·70	Claremont Hospital for Insane	Tipperary Virginia's Re-Echo (970)
Claremont Flora	do.	15961	27-8 34	10 10 36	30	24	720	3·90	27·90	Claremont Hospital for Insane	Claremont Herdsman (968)
Lansdowne Pamela	Guernsey	5688	12 9 34	4 9 36	30	17	510	3·90	19·80	J. R. Giles	Koojan Ace's Advocate (2272)
COWS 2½ YEARS AND UNDER 3 YEARS OLD—STANDARD 250 LBS. BUTTER-FAT.											
Leylands Topsy	A.I.S.	17182	18-4-33	18 11-35	273	32	11,226	4·15	465·69	D. Bevan & Sons	Parkview Commodore (306)
Illawah Lex III.	do.	11797	15 2 33	11-2-36	273	30	8,790	4·13	363·13	D. Bevan & Sons	Illawah Veteran's Hope (822)
Tabbagong Beauty 27	do.	14413	12-8-33	29-7-36	273	17	8,046	4·24	340·44	W. G. Burges	Tabbagong Regent (2018)
Walgett Water Lily	Jersey	51066	28-8-33	25-5-36	273	13	7,029	4·70	330·42	C. J. Cunningham	Mokine Centenary (7595)
Greenmount Bonetienne's Twinkle	do.	44201	24 3-33	19-2 36	273	15	5,385	6·12	329·79	A. J. B. Strempel	Bellefaire Bonaparte's Bonetienne (9224)

Longridge Bess III.	A.I.S.	17201	21-10-33	28-8-36	273	20	8,235	4·00	329·48	R. Bee & Sons	Longridge Viscount Salisbury (1519)
Koojan Golden Butterfly	Guernsey	4339	18-4-33	24-11-35	273	24	6,522	5·04	328·61	A. W. Padbury	Koojan Ace (2270)
Walgett Joy	Jersey	51064	8-7-33	25-6 36	273	7·5	5,933	5·49	325·60	C. J. Cunningham	Mokine Centenary (7595)
Lansdowne Cream Lass	Guernsey	4354	7 10 33	17-8 36	273	20	5,460	5·70	311·39	J. R. Giles	Koojan Ace's Advocate (2272)
Glanavon Sylvia	A.I.S.	10930	11 5 33	7 3-36	273	26	7,938	3·93	309·01	D. Bevan & Sons	Glanavon Nimrod (437)
Leylands Mayflower	do.	12253	1-6-33	22-1-36	273	24	7,092	4·35	308·54	D. Bevan & Sons	Mayflower's Emblem of Hillview (955)
Glanavon Dahlia	do.	10921	1-5-33	9-11-35	273	20	6,090	4·98	303·08	D. Bevan & Sons	Villiers of Darbalara (2386)
Longridge Treasure	do.	12330	2-7 33	11 2-36	273	25	6,915	4·37	302·59	R. Bee & Sons	Minathorpe Kitchener (434)
Grass Vale Golden Cream 10th	Jersey	48535	7-10-33	3-9-36	273	10	5,955	4·90	293·80	R. H. Rose	Banyule Silvermine's Twylish (7600)
Longridge Pansy	A.I.S.	17212	7-11 33	27-7 36	273	23	7,029	4·08	287·09	R. Bee & Sons	Minathorpe Kitchener (434)
Moorlands Happy	Jersey	54219	30-4-33	6-4-36	273	8·5	5,441	5·15	280·45	Estate late P. Rose	Melrose Liberty (7973)
Tipperary Champion	A.I.S.	Vol. 6	29-4 33	7-4-36	273	18	7,214	3·87	279·04	D. Bevan & Sons	Melba's Re-Echo of Tipperary (2452)
Denmark Opal	Guernsey	4122	19-9-33	26 6-36	273	12·5	5,063	5·50	278·53	Denmark Research Station	Koojan Golden Prosper (2283)
Longridge Priscilla	A.I.S.	12328	8 3-33	9-2-36	273	23	6,129	4·41	270·59	R. Bee & Sons	Minathorpe Kitchener (434)
Claremont Poppy 5th	do.	9938	4-10-33	17-4-36	273	16·5	6,350	4·20	266·67	Claremont Hospital for Insane	Tipperary Daphne's Boy (449)
Greyleigh Empress 28th	do.	16710	28-9-33	5 6-36	273	18	6,114	4·32	264·32	Prowse Bros.	Parkview Governor (928)
Grass Vale Noramine	Jersey	48537	17-11-33	11-9-36	273	9·5	5,159	5·09	262·45	R. H. Rose	Banyule Silvermine's Twylish (7600)
Lansdowne Bonnie Blossom II.	Guernsey	4351	6-8 33	16-4-36	273	20	5,460	4·75	259·38	J. R Giles	Koojan Ace's Advocate (2272)
Grass Vale Nora Twylish	Jersey	44184	4 12-32	14-11-35	273	17	5,841	4·41	257·78	R. H. Rose	Banyule Silvermine's Twylish (7600)
Tipperary Lady May	A.I.S.	14777	19-9-33	28-8 36	210	15	6,255	3·69	230·85	W. G. Burges	Parkview Rosy's Monarch (1681)
Claremont Whitby Maid 19th	do.	15978	8-2-34	8 9 36	273	16	5,748	3·90	226·84	Claremont Hospital for Insane	Claremont Herdsman (968)
Lemon Grove Buttercup 25th	do.	17136	25-7-33	11 6-36	273	11	4,848	4·57	221·44	Prowse Bros.	Alne Bank Lady's Gift (760)
Glanavon Addie	do.	16486	25-9-33	8-6 36	240	14	5,670	3·91	221·37	D. Bevan & Sons	Villiers of Darbalara (2386)
Moorlands Heda	Jersey	Vol. 24	25 6-33	20-5-36	210	5·5	3,480	5·46	190·17	Estate late P. Rose	Melrose Clarion (6931)
Lemon Grove Gracie 11th	A.I.S.	17148	10-8 33	20-5-36	273	7	4,101	4·61	189·24	Prowse Bros	Greyleigh Archer (571)
Lemon Grove Pride 8th	do.	17150	20-7-33	11-5 36	240	7	4,545	4·01	182·47	Prowse Bros.	Alne Bank Lady's Gift (760)
Summerlea Princess III.	do.	18134	21-7-33	26-5-36	240	15	4,560	3·75	170·91	Dunkley Bros.	Supreme of Summerlea (973)
Summerlea Beauty 6th	do.	18119	1-9 33	29-5-36	240	15	4,260	3·87	164·91	Dunkley Bros.	Kitchener of Summerlea (971)
Summerlea Milkmaid 13th	do.	18131	11-9-33	28-5-36	240	14	4,440	3·54	157·23	Dunkley Bros.	Kitchener of Summerlea (971)
Moorlands Hester	Jersey	54225	5-8-33	13 6-36	210	4·5	3,495	4·49	157·17	Estate late P. Rose	Melrose Liberty (7973)
Muresk Bride	Guernsey	4718	13-9-33	4-4-36	90	18·5	1,620	4·67	75·66	Muresk Agricultural College	Wollongbar Triumph (513)
Greyleigh Cinderella 28th	A.I.S.	16705	4 7-33	18-5-36	120	8	1,875	3·94	73·92	Prowse Bros.	Quenton of Greyleigh (1472)
Tipperary Bluebell	do.	18316	13-8-33	1-3-36	60	17	1,170	4·38	51 27	D. Bevan & Sons	Parkview Rosy's Monarch (1681)
Walgett Noble Duchess	Jersey	51065	16-4 33	10 4-36	60	14	840	5·05	42·42	C. J. Cunningham	Mokine Centenary (7595)

COWS 3 YEARS AND UNDER 3½ YEARS OLD—STANDARD 270 Lbs. BUTTER-FAT.

Wooroloo Duchess II.	A.I.S.	15824	15-8-32	19 11-35	273	26	9,903	4·11	407·22	E. T. Thatcher	Triumph of Pine Creek (2515)
Muresk Beauty	Guernsey	4716	21-4-33	2 10-36	273	23·5	7,571	5·27	398·81	P. G. Hampshire	Minnamurra Plaintiff (1318)
Wooroloo Wing Wing III.	A.I.S.	7748	11-5-32	1-11-35	273	25·5	8,717	4·40	383·96	Wooroloo Sanatorium Farm	Triumph of Pine Creek (251
Glanavon Sunbeam III.	do.	10929	16-10-32	28-10-35	273	19	7,437	4·92	366·04	D. Bevan & Sons	Glanavon Nimrod (437)
Westby Ulery	do.	15143	15-6-33	25-8 36	273	21	9,768	3·62	353·43	Bayley Bros.	Telyarup Duke (956)
Tabbagong Dove 11th	do.	14421	22-7-33	20-9 36	273	16	8,733	4·02	351·54	W. G. Burges	Parkview Reward II. (260)
Muresk Dessie	Guernsey	4722	20-4-33	31-5-36	273	12·5	6,953	5·04	350·23	Muresk Agricultural College	Triumph of Wollongbar (513)

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Calving.	No. of Days in Test.	Weight of Milk last day of Test.	Weight of Milk for period.	Average Test.	Weight of Butter-fat for period.	Owner.	Sire.
COWS 3 YEARS AND UNDER 3½ YEARS OLD—STANDARD 270 LBS. BUTTER-FAT—*continued.*						lb.	lb.	%	lb.		
Blacklands Ettie 9th	A.I.S.	9298	24-9-32	4-2-36	273	26	8,568	4·08	350·15	D. Bevan & Sons	Parkview Limelight (370)
Wooroloo Red Rose 5th	do.	15343	16-12-32	29-4-36	273	19·5	7,063	4·88	344·49	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Greenmount Bonetienne's Twinklette	Jersey	44202	6-8-33	23-9-36	273	18	5,894	5·80	341·85	A. J. B. Strempel	Bellefaire Bonaparte's Bonetienne (9224)
Koojan Lady Olive	Guernsey	4340	11 2 33	11-3-36	273	21	6,798	4·97	338·24	A. W. Padbury	Homestead Ace (imp. U.S.A.) (1631)
Denmark Golden Dawn	do.	4118	9-1-33	23-4-36	273	11·5	5,533	5·98	331·11	Denmark Research Station	Koojan Golden Prosper (2283)
Walgett Handsome Girl II.	Jersey	51062	12-11-32	10 3-36	273	17	5,946	5·46	324·79	C. J. Cunningham	Mokine Centenary (7595)
Muresk Jennie	Guernsey	4727	15-5 33	18-5-36	273	12	6,426	5·04	323·94	Muresk Agricultural College	Triumph of Wollongbar (513)
Muresk Rosebud	do.	4732	4-7-33	12-8-36	273	13·5	5,891	5·39	317·61	Muresk Agricultural College	Minnamurra Plaintiff (318)
Denmark Prosper's Rosa	do	4127	27-12-32	21 6-36	273	13	5,777	5·49	316·96	Denmark Research Station	Koojan Golden Prosper (2283)
Westby Pearl	A.I.S.	15140	19-2-33	1-4-36	273	16·5	7,901	3·99	314·52	Bayley Bros.	Telyarup Duke (956)
Blacklands Thelma 7th	do.	9393	3-12-32	1-3-36	273	24	7,842	4·12	313·43	D. Bevan & Sons	Parkview Limelight (370)
Longridge Milkmaid	do.	12327	24-11-32	10 2 36	273	26	6,798	4·44	301·79	R. Bee & Sons	Minathorpe Kitchener (434)
Tirano Rosie	do.	...	16-6-33	28-7-36	273	12	7,206	4·16	299·98	A. Della	Bryn-y-mar Charmer (266)
Westby Lupin II.	do.	15139	6-9-33	12-9 36	273	23	8,124	3·67	298·45	Bayley Bros.	Telyarup Duke (956)
Glanavon Dulcie	do.	10924	13-2-33	3-5 36	273	22	7,596	3·92	297·48	D. Bevan & Sons	Villiers of Darbalara (2386)
Walgett Handsome Girl III.	Jersey	51063	12-11 32	25-4-36	273	14	5,562	5·27	293·34	C. J. Cunningham	Mokine Centenary (7595)
Glanavon Vida II.	A.I.S.	16495	25-5-33	3-9-36	273	13	7,149	4·03	288·33	E. T. Thatcher	Glanavon Nimrod (437)
Grass Vale Lady Fowler 17th	Jersey	48536	6 5-33	3-8-36	273	4	5,802	4·95	287·44	R. H. Rose	Banyule Silvermine's Twylish (7600)
Koojan Pretty Polly	Guernsey	4341	13-9-32	20-1-36	273	14	6,327	4·42	279·80	A. W. Padbury	Homestead Ace (imp. U.S.A.) (1631)
Blacklands Charmer III.	A.I.S.		25-12-32	5 5-36	273	15	6,555	4·24	278·07	D. Bevan & Sons	Emperor of Blacklands
The Wold Daisy Grey II.	Jersey	46428	28-3-33	20-4-36	273	14·5	5,474	5·0	273·30	L. C. Field	Lonswood Lord Grey (7291)
Sabina Vale Silvermine III.	do.	50540	25-5-33	23-7-36	273	11·5	5,007	5·42	271·05	Sabina Vale Stud Farm	Glen Iris Matilda's Lord (9491)
Lemon Grove Fussy 6th	A.I.S.	17144	10-5-33	27-5-36	240	13	6,540	3·91	256·74	Prowse Bros.	Alne Bank Lady's Gift (760)
Denmark Pride	Guernsey	4124	16-2-33	25-5 36	273	7	4,486	5·53	247·99	Denmark Research Station	Koojan Golden Prosper (2283)
Grass Vale Golden Cream 9th	Jersey		16-8-33	31 8-36	210	9·5	4,155	5·53	229·71	R. H. Rose	Banyule Silvermine's Twylish (7600)
Glanavon Pink Pearl	A.I.S.	10927	17-6-32	11-12-35	210	22	5,970	3·74	225·15	D. Bevan & Sons	Villiers of Darbalara (2386)
Sabina Vale Silvermine IV.	Jersey		3-6-33	12-7 36	273	11	4,053	5·46	221·47	Sabina Vale Stud Farm	Banyule Ettric (9200)
Blacklands Buttercup 6th	A.I.S.	9282	6-11-32	4-5 36	210	20	5,190	4·23	219·51	D. Bevan & Sons	Orama of Blacklands (1905)
Denmark Prosper's Mona	Guernsey	4126	2 2-33	17-5-36	273	9·5	4,889	4·22	206·20	Denmark Research Station	Koojan Golden Prosper (2283)
Claremont Star 9th	A.I.S.	9945	15-9-32	6 1-36	180	12	4,710	4·06	191·34	Claremont Hospital for Insane	Tipperary Virginia's Re-Echo (970)
Summerlea Swallow 4th	do.	18138	27 6-33	24-6-36	180	22	5,160	3·50	180·66	Dunkley Bros.	Kitchener of Summerlea
Summerlea Tulip 9th	do.	12573	2-3-33	28-6-36	180	20·5	4,335	4·00	173·49	Dunkley Bros.	Searchlight of Summerlea (972)
Sabina Vale Silvermine II.	Jersey	55177	29 9-32	23-10-35	273	11·5	3,875	4·28	165·82	Sabina Vale Stud Farm	Banyule Ettric (9200)
Avon Picure	A.I.S.	10926	19 3-33	3-5-36	150	24	3,510	4·17	146·94	D. Bevan & Sons	Villiers of Darbalara (2386)

Leylands Melba	do.	17170	1-9-33	21-11-36	60	53	3,180	4·00	126·36	D. Bevan & Sons	Widgee Waa Record (848)
Glanavon Dahlia	do.	10921	1-5-33	18-10-36	60	37	2,220	3·73	82·74	D. Bevan & Sons	Villiers of Darbalara (2386)
Wooroloo Fairy	do.	15328	7-8 33	4-9-36	60	21·5	1,485	3·84	57·03	Wooroloo Sanatorium Farm	Wooroloo Prince (2974)

COWS 3½ YEARS AND UNDER 4 YEARS OLD—STANDARD 290 Lbs BUTTER-FAT.

Longridge Royal Lady	A.I.S.	12329	22-10-32	26-4 36	273	28	9,534	4·49	428·52	R. Bee & Sons	Minathorpe Kitchener (434)
Greenmount Milkmaid	Jersey	40102	2-5-32	9-2-36	273	22	7,491	5·43	406·88	A. J. B. Strempel	Grantham Easter King (6510)
Claremont Cleggett 6th	A.I.S.	9918	15-12-32	24-8-36	273	26	9,483	3·90	374·43	Claremont Hospital for Insane	Claremont Herdsman (968)
Lansdowne Morden Lady	Guernsey	3479	10-11-31	1-11-35	273	16	7.233	5·19	374·20	P. G. Hampshire & Son	Koojan Golden Broadcaster (1632)
Blacklands Cowslip 6th	A.I.S.	9288	4-12 32	14 6-36	273	22	8,736	4·10	358·30	D. Bevan & Sons	Emperor of Blacklands (947)
Leylands Topsy	do.	17182	18-4-33	19-10-36	210	18	9,450	3·79	358·20	D. Bevan & Sons	Parkview Commodore (306)
Blacklands Rosette II.	do.	9389	4-5-32	2-4-36	273	24	9,012	3·97	357·52	D. Bevan & Sons	Blacklands Major (369)
Blacklands Fairy 12th	do.	9301	6-5 32	4-6 36	273	18	8,934	3·89	347·08	D. Bevan & Sons	Orama of Blacklands (1905)
Blacklands Poppy 5th	do.	9372	13-10-32	4 6-36	273	16	8.552	3·77	322·65	D. Bevan & Sons	Blacklands Major (369)
Denmark Orangebud	Guernsey	4123	9-8-32	11-6-36	273	15·5	6,850	4·54	310·81	Denmark Research Station	Koojan Golden Prosper (2283)
Grass Vale Lady Fowler 16th	Jersey	44183	2-9-32	29 8-36	273	9·5	5,849	5·30	310·13	R. H. Rose	Banyule Silvermine's Twylish (7600)
Wooroloo Wing Wing 4th	A.I.S.	7749	11-5 32	14-2-36	273	17	6,911	4·38	302·61	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Tirano Charming Dinah	do.		28 6 32	28-3-36	273	25	8,040	3·75	301·95	A. Della	Bryn-y-mar Charmer (266)
Moorlands Glide	Jersey	45237	5-8-32	27-3-36	273	12	5,916	4·92	291·31	Estate late P. Rose	Melrose Clarion (6931)
Blacklands Miss Ettie III.	A.I.S.	9354	15-5-32	26-1-36	273	15	7,050	4·01	282·69	W. G. Burges	Emperor of Blacklands (947)
Crantock Starbright's Napoleonette	Jersey	52400	27-11-32	28-8-36	273	8	5.409	5·07	274·31	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Greenmount Charming Queen	do.	40099	9-6-32	6-2-36	273	15·5	4,764	5·66	269·89	A. J. B. Strempel	Grantham Easter King (6510)
Sabina Vale Silvermine	do.	50539	29-3 32	27-2-36	273	18	5,679	4·72	267·79	Sabina Vale Stud Farm	Banyule Lord Silvair (5752)
Sabina Vale Pansy	do.	55176	23-11-32	2 7-36	273	11·5	5,960	5·11	258·80	Sabina Vale Stud Farm	Glen Iris Matilda's Lord (9491)
Claremont Treasure 7th	A.I.S.	8333	14-5-32	29 4-36	273	17·5	7.951	3·22	255·81	A. E. Grant	Claremont Elector (446)
Crantock Napoleon's Susanette	Jersey		28-10-32	15-1 36	273	11	4,420	5·49	242·54	Mrs. G. H. Burnside	Crantock Starbright Napoleon
Numbawarra Blossom	A.I.S.	17613	2 9-32	19-5 36	210	8	4,815	4·07	195 84	Prowse Bros.	Numbawarra Flashlight (144)
Moorlands Guitar	Jersey	49634	17-7-32	14 6-36	210	5·5	3,555	4·96	176·34	Estate late P. Rose	Melrose Liberty (7973)
Muresk Princess	Guernsey	3879	3-5-32	15-4-36	90	28	2,160	4·48	96·66	Muresk Agricultural College	Nundorah Climax

COWS 4 YEARS AND UNDER 4½ YEARS OLD—STANDARD 310 Lbs. BUTTER-FAT.

Blacklands Beauty 10th	A.I.S.	9279	2-4-32	20-6-36	273	32	12,621	4·14	522·64	W. G. Burges	Fussy's Monarch of Hillview (493)
Brookfields Lady Faith	Guernsey	4062	19-6-32	4-9-36	273	29	9,957	4·86	483·50	P. G. Hampshire & Son	Koojan Lord Barclay (1031)
Koojan Ace's Mignonette	do.	3898	23-4-32	16-9-36	273	21·5	6,905	6·73	464·73	A. W. Padbury	Homestead Ace (imp. U.S.A.) (1631)
Westby Lupin	A.I.S.	15138	28 3-32	23-7 36	273	22·5	11,947	3·87	462·28	Bayley Bros.	Telvarup Duke (956)
Longridge Melba	do.	7666	16 11-31	27-4-36	273	31	9,543	4·35	415·03	R. Bee & Sons	Minathorpe Kitchener (434)
Muresk Duchess	Guernsey	4724	2-8 32	12-8-36	273	16·5	6,560	5·51	361·22	Muresk Agricultural College	Denmark Empire Chief (1268)
The Wold Northwood Grey	Jersey	42214	15 5-32	25 6-36	273	8	6,774	5·33	360·78	L. C. Field	Lonswood Lord Grey (7291)
Walgett Handsome Girl	do.	42402	1-12 31	13 4-36	273	15·5	6,092	5·57	339·69	C. J. Cunningham	Burekup Campanile's Duke (7287)
Sabina Vale Countess	do.	55175	27-4 32	31 7 36	273	13·5	6,011	5·60	338·17	Sabina Vale Stud Farm	Belletaire Seaborn Successor (6824)
Radyr Park Laddie's Estrellita	do.	45846	16 7-32	26-8-36	273	7·5	5,347	6·17	330·00	L. Temple	Graceful Lad of Greenmount (7292)
Radyr Park Dorothy	do.	45844	27-7-31	5 10-35	273	10·5	6,467	5·08	328·94	L. Temple	Melrose Clarion (6931)
Blacklands Red Myrtle II.	A.I.S.	9381	21-7 31	16-11-35	273	19	7,272	4·51	327·88	W. G. Burges	Blacklands Major (369)

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Calving.	No. of Days in Test.	Weight of Milk last day of Test.	Weight of Milk for period.	Average Test.	Weight of Butter-fat for period.	Owner.	Sire.
						lb.	lb.	%	lb.		
COWS 4 YEARS AND UNDER 4½ YEARS OLD—STANDARD 310 LBS. BUTTER-FAT—*continued.*											
Westby Polly	A.I.S.	15141	21-5-32	24-9-36	273	12·5	8,438	3·82	322·61	Bayley Bros.	Telyarup Duke (956)
Denmark Golden Marie	Guernsey	3873	26-4-32	18-6-36	273	10·5	5,245	5·73	300·31	Denmark Research Station	Koojan Golden Prosper (2283)
Denmark Prosper's Velvet	do.	3875	23-3-32	13-7-36	273	6·5	5,127	5·64	289·61	Denmark Research Station	Koojan Golden Prosper (2283)
Claremont Star 7th	A.I.S.	9944	23-8-32	26-8-36	273	19	7,152	4·0	285·05	Claremont Hospital for Insane	Claremont Herdsman (968)
Sabina Vale Lotus	Jersey	46111	16-1-32	3-7-36	273	14·5	5,519	5·12	282·78	Sabina Vale Stud Farm	Banyule Airo (5751)
Glanavon Gold	A.I.S.	10925	25-6-32	24-8-36	210	17	7,080	3·94	279·03	D. Bevan & Sons	Villiers of Darbalara (2386) A.M.S.
Fairfield Royal Lu Lu	do.	10719	23-3-32	28-8-36	180	33	6,645	4·13	274·68	W. G. Burges	Kinsman of Greyleigh (111) I.M.S.H.B.
Blacklands Miss Tottie 4th	do.	9365	12-4-32	12-7-36	273	20	6,780	4·01	271·62	A. E. Grant	Orama of Blacklands (1905)
The Wold Starbright Grey	Jersey	42215	9-5-32	20-6-36	240	9·5	5,295	5·07	268·26	L. C. Field	Lonswood Lord Grey (7291)
Salem View Queen	A.I.S.	17999	17-12-31	12-5-36	273	17	6,291	4·26	268·01	Prowse Bros.	Fairfield Marmaduke (791)
The Wold Daisy Grey	Jersey	42213	18-5-32	7-8-36	273	7	5,271	5·01	264·17	L. C. Field	Lonswood Lord Grey (7291)
Tirano Primrose	A.I.S.	Vol. 6	25-3-32	28-5-36	273	19·5	6,719	3·93	264·11	A. Della	Bryn-y-mar Charmer (266)
Grass Vale Golden Cream 7th	Jersey	44182	19-7-32	1-9 36	240	7·5	4,838	5·31	256·79	R. H. Rose	Banyule Silvermine's Twylish (7600)
Glanavon Esmeralda	A.I.S.	6728	24-9-31	12-3-36	210	26	5,460	4·61	251·55	D. Bevan & Sons	Villiers of Darbalara (2386)
Blacklands Pretty Maid 6th	do.	9376	25-2-32	10-8 36	240	15	6,975	3·79	245·73	A. E. Grant	Orama of Blacklands (1905)
Moorlands Grace	Jersey	45241	3-5-32	1-6-36	180	9·5	3,825	5·97	226·83	Estate late P. Rose	Melrose Sultan (6930)
Wooroloo Betty III.	A.I.S.	7735	17-12-31	1-6-36	210	13·5	4,320	4·13	178·26	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
COWS 4½ YEARS AND UNDER 5 YEARS OLD—STANDARD 330 LBS. BUTTER-FAT.											
Lansdowne Morden Lady	Guernsey	3479	10-11-31	6-10-36	273	29·5	9,059	5·48	496·62	P. G. Hampshire & Son	Koojan Golden Broadcaster (1632)
The Wold Easter Daisy	Jersey	34731	5-6-31	14-5-36	273	11	8,043	5·37	431·99	L. C. Field	Grantham Easter King (6510)
Koojan Bo-peep	Guernsey	3542	26-2-31	2-11-35	273	25	7,755	5·53	429·10	A. W. Padbury	Homestead Ace (imp. U.S.A.)(1631)
Wooroloo Sunshine	do.	5227	13-2-31	19-11-35	273	16·5	6,920	4·79	331·55	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Muresk Zinnia	Guernsey	3294	14-10-31	24-6-36	240	30·5	6,570	4·98	325·65	Muresk Agricultural College	Milton Victory II. (611)
Walgett Duchess	Jersey	42400	20-8 31	25-5-36	273	11·5	6,140	5·13	314·73	C. J. Cunningham	Burekup Campanile's Duke (7287)
Greenmount Marinette	do.	34840	24-5-31	4-5 36	273	17	6,186	4·95	306·17	A. J. B. Strempel	Grantham Starbright's King (5796)
Denmark Prosper's Dinah	Guernsey	3272	7-12-31	28-6-36	273	10·5	5,567	5·48	305·51	Denmark Research Station	Koojan Golden Prosper (2283)
Tlabbagong Beauty 19th	A.I.S.	7502	20-12 31	8-3-36	273	16	7,021	4·27	299·91	A. E. Grant	Parkview Reward II. (260)
Blacklands Miss Jean 6th	do.	9356	21-8 30	17-2-36	273	5	6,825	4·39	299·59	W. G. Burges	Red Prince of Blacklands (1064)
Willow Glen Katoomba	do.	6731	26-4-31	2-1-36	273	20	7,140	4·16	297·37	A. Della	Berry Morning Star (168)
Moorlands Fanny	Jersey	41097	7-6-31	14-3-36	273	7·5	5,303	5·05	267·61	Estate late P. Rose	Melrose Raleigh (5860)

Denmark Prosper's Lady	Guernsey	3273	6-12-31	6-8-35	273	11	4,376	5·67	249·21	Denmark Research Station	Koojan Golden Prosper (2283)
Summerlea Beauty 4th	A.I.S.	14237	2-8-31	8-6-36	210	23	5,790	3·82	229·65	Dunkley Bros. ..	Victor of Telyarup (2498)
Radyr Park Clarion Call	Jersey	45843	5-7-31	9-2-36	273	12	3,501	6·31	221·03	L. Temple	Melrose Clarion (6931)
Claremont Lupin 8th	A.I.S.	5103	19-3-31	23-11-35	240	6	6,150	3·59	220·59	Bayley Bros.	Claremont Elector (446)
Grantham Easter Fairy	Jersey	34825	18-9-31	8-5-36	60	36·5	2,055	5·10	105·57	J. A. Sears	Greenmount Black Prince (6511)

COWS 5 YEARS AND OVER—STANDARD 350 LBS. BUTTER-FAT.

Yallah Farm Maggie II.	A.I.S.	1272	30-8-28	24-8-36	273	37	17,541	3·86	677·21	W. G. Burges	Fussy's Favo of Parkview (2149)
Springpark Starbright's Queen	Jersey	24901	16-3-28	1-5-36	273	36	10,808	6·09	659·16	Robinson Bros.	Prince Marinora of Grass Vale (4582)
Nancy 9th of Raleigh	A.I.S.	17519	30-4-27	22-10-35	273	36	10,998	5·06	556·62	D. Bevan & Sons	Union Jack of Raleigh (2375)
Tabbagong Dove IV.	do.	14725	30-9-26	20-8-36	273	16	12,618	4·06	512·64	W. G. Burges ...	Mayflower Repeater of Hillview (905)
Tabbagong Fairy 8th	do.	7514	14-7-31	1-9-36	273	23	10,989	4·56	471·55	W. G. Burges ...	Parkview Reward II. (260)
Travalgan Lady Mint	Jersey	34789	21-6-30	19-7-36	273	20	7,770	5·95	462·59	Robinson Bros.	Tessie's Masterpiece of Garden Hill (6506)
Brookfields Lady Lilian ...	Guernsey	2720	28-11-29	27-7-35	365	16·5	11,108	5·18	575·23	P. G. Hampshire	Koojan Lord Barclay (1031)
					273	25	9,525	4·8	456·42		
Blacklands Jeanette 7th	A.I.S.	9324	1-1-31	19-6-36	273	17	11,391	3·93	447·49	W. G. Burges	Fussy's Monarch of Hillview (493)
Newry Lady Freda	Guernsey	2719	13-9-28	27-1-36	273	24	7,872	5·6	440·79	P. G. Hampshire	Koojan Mack (596)
Grangelea Pretty Primrose	Jersey	33038	31-10-29	2-9-36	273	24	7,692	5·48	421·60	Sabina Vale Stud Farm	Banyule Airo (5751)
Minnamurra Palmolive	Guernsey	2616	30-8-29	19-4-36	273	18	7,884	5·34	421·33	Muresk Agricultural College	Caramana Favour (652)
Karridale Girlie	do.	3820	24-9-30	16-9-36	273	22·5	8,138	5·18	415·72	P. G. Hampshire	Minnamurra Rose Chief (1016)
New Park Sally 9th	A.I.S.	1873	30-4-29	16-5-36	240	18	11,250	3·67	412·92	W. G. Burges	Ruler of Greyleigh (1855)
Springmead Josephine	Jersey	42003	10-6-31	29-9-36	273	8·5	6,761	5·99	405·28	Robinson Bros.	Bellefaire Blonde's Corsican (7040)
Karridale Pride	Guernsey	1981	16-10-27	18-4-36	273	23	7,929	5·08	398·80	P. G. Hampshire	Minnamurra Oliver Twist (528)
Parkview Lady May 23rd	A.I.S.	13236	1-6-31	4-10-36	273	23	10,389	3·81	396·16	W. G. Burges ..	Daphne's Defiance of Hillview (Found)
Grass Vale Lily's Pride	Jersey	28228	10-2-29	23-3-36	273	26	7,548	5·29	394·92	C. J. Cunningham	Starbright's Sweet Duke of Glen Iris (3710)
Wingeewah Winnie 7th	A.I.S.	4395	20-3-30	24-5-36	273	28·5	9,964	3·94	393·09	A. E. Grant	Daphne's Defiance of Hillview (Found)
The Wold Starbright Daisy	Jersey ...	31179	8-7-30	4-6-36	273	11	7,256	5·37	389·76	L. C. Field	Grantham Starbright's King (5796)
Grantham Lady Fowler 5th	do.	28231	17-5-29	11-8-36	273	11	5,958	6·49	387·13	L. Temple	Grantham Starbright's King (5796)
Glanavon Penelope	A.I.S.	2366	21-8-30	1-1-36	273	23·5	9,086	4·24	385·25	D. Bevan & Sons ...	Villiers of Darbalara (2386)
Wingee Wah Kate III.	do.	1535	20-3-29	7-10-35	273	26	10,953	3·52	385·01	A. Della	Daphne's Defiance of Hillview (Found)
Minnamurra Sunlady	Guernsey	2811	25-2-30	19-7-36	273	13	6,819	5·61	382·49	Muresk Agricultural College	Minnamurra Justice (1012)
Koojan Dorothy	do.	1613	27-6-26	3-7-36	273	18	7,854	4·86	381·62	J. R. Giles	Koojan Golden Governor (595)
Moorlands Dot	Jersey	31236	16-5-29	18-7-36	273	13·5	6,131	6·21	380·81	L. Temple	Melrose Romeo (5861)
Koojan Morden Lady 4th	Guernsey	1901	23-9-26	9-5-36	273	16	6,933	5·47	379·68	J. R. Giles	Robin of Nundorah (417)
Tipperary Royal Lady	A.I.S.	2377	13-11-28	5-2-36	273	24	9,462	4·00	376·73	R. Bee & Sons ..	Tipperary Melba's Re-Echo (2452)
Muresk Daisy	Guernsey	2155	16-6-28	28-3-36	273	22·5	8,303	4·51	374·99	Muresk Agricultural College	Wollongbar Triumph (513)
Summerlea Milkmaid IV.	A.I.S.	5135	3-11-28	7-3-36	273	30	10,650	3·52	374·56	Dunkley Bros. ..	Victor of Telyarup (2498)
Minnamurra Prairie Belle	Guernsey	2619	2-11-29	11-5-36	273	14·5	7,334	5·10	374·24	Muresk Agricultural College	Minnamurra Rex (1322)
Wooroloo Lass	A.I.S.	7740	30-12-29	2-1-36	273	29	9,732	3·83	373·03	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Wyuna Jean	Guernsey	2471	8-9-29	22-6-36	273	13	7,659	4·85	371·47	Muresk Agricultural College	Nundorah Buccaneer (612)

HERD TESTING—*continued*.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Calving.	No. of Days in Test.	Weight of Milk last day of Test.	Weight of Milk for period.	Average Test.	Weight of Butter-fat for period.	Owner.	Sire.
						lb.	lb.	%	lb.		
COWS 5 YEARS OLD AND OVER—STANDARD 350 LBS. BUTTER-FAT—*continued*.											
The Pine's Bell	A.I.S.	4079	6-9-30	21-7-36	273	17	9,216	4·01	369·86	E. T. Thatcher	Democrat of Alne Bank (1625)
Summerlea Tulip 3rd	do.	5140	2-8-29	18-4-36	273	27	9,561	3·86	369·24	Dunkley Bros.	Victor of Telyarup (2498)
Muresk Rose	Guernsey	2156	9-5-28	9-8-36	273	6	6,918	5·33	368·91	Muresk Agricultural College	Triumph of Wollongbar (513)
Minnamurra Judy	do.	1868	4-4-27	3-7-36	273	14	6,432	5·68	365·59	J. R. Giles	Judge of Wollongbar (184)
Newstead Daisy 12th	A.I.S.	12955	28-5-30	14-8-36	273	18	8,784	4·16	365·26	W. G. Burges	Superb of Newstead (2911)
Wooroloo Bloomer	do.	5218	5-10-30	2-4-36	273	20	8,280	4·35	360·71	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Berrington Soprano 2nd	Jersey	28851	5-10 29	15-8 36	273	14	8,122	4·43	359·79	Sabina Vale Stud Farm	Banyule Super-strain (4529)
The Wold Daisy Northwood	do.	25064	11-7-28	16-4-36	273	13·5	6,086	5·91	359·65	L. C. Field	Grass Vale Northward King (5620)
Kurrawong Bluebell 10th	A.I.S.	4245	5-12-30	20-4-36	273	11	8103	4·37	354·45	D. Bevan & Sons	Standard of Cosy Camp (2695)
Wooroloo Jean	do.	5221	15-7-30	1-8-36	273	20	8,790	4·03	354·27	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Crantock Cream Lass	Jersey		7-6 31	1-9-36	273	7·5	5,227	6·66	348·62	Mrs. G. H. Burnside	Crantock Starbright's Napoleon
Walgett Fortune	do.	42401	10-11 30	9-5-36	273	8·5	6,911	5·03	347·66	C. J. Cunningham	The Valley Twylish Fox (5623)
Greenmount Starbright Mavinora	do.	34841	31-5-30	3-4-36	273	15	5,895	5·84	344·20	A. J. B. Strempel	Werribee Starbright Butter-king
Nancy 9th of Raleigh	A.I.S.	17519	30-4-27	5-10-36	210	17	7,170	4·60	330·15	D. Bevan & Sons	Union Jack of Raleigh (2375)
Wingeewah Silver III.	do.	1547	4-10-28	31-5-36	273	8	7,689	4·28	329·09	A. Della	Karawara Werri (2759)
Crantock Lady Bluebell	Jersey	34724	26-5-29	11-8-36	273	8·5	5,680	5·58	317·02	Mrs. G. H. Burnside	Crantock Starbright's Chief (5790)
Moorlands Evelyn	do.	34811	28-8-30	28 2-36	273	12	6,411	4·90	314·08	Estate late P. Rose	Melrose Romeo (5861)
Grangelea Buttercup	do.	26388	21-3-27	2 6-36	273	14·5	6,524	4·81	313·90	Sabina Vale Stud Farm	Grangelea Daisy's V.C. (5079)
Grass Vale Golden Cream III.	do.	34815	22-8-29	25-10-35	240	16·5	6,098	5·13	312·97	R. H. Rose	Choice Goods of Garden Hill (4580)
Moorlands Ethel	do.	34808	2-4-30	28-3-36	240	14·5	5,620	5·53	310·65	Estate late P. Rose	Melrose Raleigh (5860)
Wooroloo Margaret	A.I.S.	5233	7-10-30	25-8-36	273	15·5	7,337	4·23	310·08	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Grass Vale Sweet Maggie II.	Jersey	28229	27-3 29	1-10-36	273	13	6,739	4·59	309·64	R. H. Rose	Starbright's Sweet Duke of Glen Iris (3710)
Clarendon Eyre Betty	do.	39244	28-4-28	21-5-36	273	17	8,055	3·79	305·10	Sabina Vale Stud Farm	Clarendon Eyre Eminent's Achievement (4154)
Spurfield Eastern Jewel	Guernsey	2390	1 12-29	26-8-36	273	14	6,087	4·95	301·21	Muresk Agricultural College	Spurfield Eastern King (1186)
Denmark Rose Pearl V	do.	3281	20-8 30	1-7 36	273	8	5,289	5·59	295·89	Denmark Research Station	Reformer of Wollongbar (538)
Wyuna Lady Dawn	do.	2472	12-11 29	15-6-36	273	7	5,766	4·98	287·28	Denmark Research Station	Nundorah Prosper (664)
Minnamurra Eleanor	do.	2607	13-8 29	13-7-36	273	6	6,153	4·46	274·33	Muresk Agricultural College	Caramana Favour (652)
Mondah Princess III.	A.I.S.		7-4-30	20-5-36	273	18	6,684	4·05	270·55	A. Della	Pine Creek Banker (450)
Kurrawong Nancy 5th	do.	4246	26-4-30	1-3-36	240	35	7,830	3·40	266·31	Dunkley Bros.	Standard of Cosy Camp (2695)
Flash of Eastview	do.	18331	4-10-28	14-8-36	240	15	6,975	3·79	264·15	A. E. Grant	Mariner of Greyleigh (587)
Tirano Princess	do.	7677	22-12-30	26-5-36	273	14·5	6,479	4·00	259·46	A. Della	Pine Creek Banker (450)
Crantock Starbright Duchess	Jersey	39440	15-10-30	5-7-36	273	9	4,302	6·03	259·28	Mrs. G. H. Burnside	Crantock Starbright's Chief (5790
Willow Glen Ruby VI.	A.I.S.		18-8-25	15-5-36	273	30	7,575	3·39	256·65	A. Della	Lord Denmore of Willow Glen (1111)

dy Fowler V. ..	Jersey ...	28231	17-5-29	11-8-36	273	11	5,958	6·49	242·32	L. Temple	Crantock Starbright's King (5796)
Crantock Lady Primrose .	do. ...	..	10-6-31	27-6-36	273	9	4,250	5·40	229·51	Mrs. G. H. Burnside	Crantock Starbright's Montrose (5945)
Moorlands Clara	do. ...	28215	18-8-28	24-5-36	210	4	5,070	4·42	223·98	Estate late P. Rose ..	Grafter of Melrose (3560)
Greenmount Gentle Lass .	do.	34838	9-8-31	3-9-36	150	21	4,590	4·85	222·56	A. J. B. Strempel ..	Grantham Starbright's King (5796)
Moorlands Bridget .. .	do. ..	24920	1-6-27	10-5-36	240	4	5,085	4·21	213·93	Estate late P. Rose ..	Colonel of Melrose (4015)
Crantock Lady Buttercup .	do. ...	39439	21-5-30	21-9-36	240	10	3,645	5·62	205·19	Mrs. G. H. Burnside	Crantock Starbright's Montrose (5945)
Moorlands Aline	do. ..	23683	16-7-26	28-5-36	210	13	5,085	3·82	194·43	Estate late P. Rose ..	Colonel of Melrose (4015)
Moorlands Elsie	do. .	34803	12-6-30	2-4-36	240	7·5	4,110	4·67	191·85	Estate late P. Rose	Melrose Romeo (5861)
Moorlands April . .	do. ..	23687	3-9-26	17-8-36	150	13	3,930	4·59	179·79	Estate late P. Rose .	Colonel of Melrose (4015)
Moorlands Chloe .. .	do.	28214	2-5-28	14-9 36	120	12·5	3,030	4·41	133·56	Estate late P. Rose	Colonel of Melrose (4015)
Greenmount Little Gem .	do. ...	34839	9-6-31	7-7-36	60	36	2,340	4·77	111·75	A. J. B. Strempel	Grantham Easter King (6510)
Travalgan Ice Cream . . .	do. ..	34788	6-2-31	13-5-36	60	27	1,725	4·64	79·98	Robinson Bros.	Banyule Altitude (5793)
Muresk Poppy	Guernsey	3293	8-8-30	24-5-36	60	21·5	1,320	5·34	70·47	Muresk Agricultural College	Triumph of Wollongbar (513)
Grantham Lady Fowler III. .	Jersey ...	24033	7-7-28	2-6-36	60	29·5	1,590	5·07	80·70	J. A. Sears	Merry King of Greenmount (4306)
Grantham Air Lady	do. ..	34824	18-7-30	28-4-36	30	30	900	5·1	46·14	J. A. Sears	Banyule Altitude (5793)
Hillview Fussy 34th	A.I.S. ..	4496	3-9-30	13-11-36	30	28·5	855	3·9	33·78	A. E. Grant .	Limelight of Hillview (954) I.M.S.

CONSERVATION OF FODDER IN THE WHEAT BELT.

F. L. Shier, Senior Agricultural Adviser.

It is characteristic of the wheat belt areas of this State that they experience two main seasons annually—the wet portion during which the growth of crop and pasture takes place, and the dry period when there is no growth. This dry period, which lasts up to six or seven months, has been frequently and aptly referred to as an annual drought. The farmer is, therefore, faced with the problem of adjusting his flocks and arranging his farm practices so as to carry his stock over the long dry period of several months on pastures or other fodders that have been produced during the previous winter and spring. Most farmers are reasonably stocked during the winter and spring, but it is not infrequent that it is found that the dry pastures and stubble grazings are insufficient in quantity and/or quality to carry the same number of stock through or provide for their particular requirements during the dry period. Losses occur, not infrequently, due to the poor nutritional condition of the natural grazing, whilst in other cases some farmers may be forced to dispose of portion of their stock when the market is usually low and prices unfavourable, or, on the other hand, to purchase fodders which are expensive. When the cost of such fodders is considered it is not unusual to find there is little or no profit left for the farmer. The obvious manner in guarding against deaths, financial losses due to forced sales, and the uneconomic purchase of expensive fodders, is by the conservation of fodders which have been grown on the farm during the winter and spring for hand-feeding to the stock during the late summer and autumn.

This lean period of the year, when the grazing available to the stock is low both in quantity and quality, varies, of course, with the feed available at the commencement of the summer and the intensity of the stocking. It is a recognised fact that, as the plant approaches maturity, the composition and digestibility falls. There is a passage of considerable amounts of the food materials from the leaves to the seed, and also a change of the digestible cellulose portions to a highly indigestible woody fibre. The mature plant as a whole is, therefore, not so valuable to the animal as it was before maturity. However, stock do very well on mature pasture due to their ability to graze selectively, i.e., eating the more leafy and grain portions. This is amply demonstrated in clover, trefoil and lupin pastures. These plants are of particular value during the dry period on account of the large amount of highly nutritious seed. It is also shown in the case of cereal stubble. Stock will actually gain weight when first placed on such grazing and until they have eaten out the unthreshed heads, lost grain and flag.

Conserved fodder is not only necessary to overcome the gross deficiencies during the lean period, but is also required for the more specific requirements of the different types of stock. A farmer's flock generally consists of wethers, ewes and young sheep (lambs or weaners). Each of these types is kept for a different purpose, has different functions to perform, and, therefore, has different food requirements.

Wethers generally can be carried over the dry period without any supplementary feeding. They naturally lose weight, but, provided they are in a healthy condition, this loss of weight does not affect them adversely. When the green feed comes they quickly regain their weight and produce wool yields which are very little less than that which would have been obtained if they had been maintained at their pre-summer weight. The extra wool which would have resulted

would not pay for the extra feed given to maintain that weight. These contentions have been amply supported by the results obtained at the Meckering and Avondale Research Stations (during 1933-1936) where data on body weights and wool yields were obtained in connection with the Toxic Paralysis investigations. Where the feed is particularly low, however, and the wethers show signs of becoming weak, a good roughage, such as hay, chaff or meadow hay, at about 1 lb. per day would be sufficient to keep them in a reasonably thrifty condition.

Weaners.—It has been shown by many workers that nutritional conditions in early life and limiting growth can materially affect the ultimate development of the animal. Furthermore, good nutritional conditions greatly minimise the effect of worm parasites. Weaners have definite growth requirements and a protein or grain supplement is necessary. Whilst it may not be possible or economic to keep such animals growing at a maximum rate all the time, farmers should be prepared to supplement their feed to some extent. Sufficient grain should be available to provide approximately ½ lb. per head per day for a period of three months.

Mated Ewes.—Mating, pregnancy and lambing take place during the worst period of the year, but whilst good nutritional conditions prior to service is most favourable for fertility, contrary to the generally accepted belief, the ewe has little extra food requirements until the last third of the pregnancy period. During this period she must supply the needs of the rapidly developing foetus, and provide for the growth of the milk secreting tissue of the udder. The requirements for growth, i.e., a protein diet, are needed for this. Good young green pasture or crop in quantity is undoubtedly the best. Our normal season, however, does not generally permit of this, and, in consequence, supplies of grain, such as wheat, oats or peas, should be further conserved so as to further supplement the pregnant ewe with a more protein diet. Such a supplement at about ½ lb. per sheep per day, with a good roughage, if required, for a period of about 6 to 8 weeks prior to lambing would be of extreme value for the best results.

Adequate reserves of fodder are also necessary to guard against the disastrous losses both of ewes and lambs which frequently occur when the seasonal winter rains are late and no natural feed is available. This is of importance in the export lamb districts, where lambing generally takes place earlier than in other districts.

Silage.—Some farmers in the export lamb areas also specialise in the production of very early lambs: mating is so arranged that lambs can be expected before any green feed appears. Under such circumstances the value of a succulent feed cannot be over-emphasised. In occasional instances there are small moist areas where green fodders can be grown for this purpose. Moreover, in some seasons, early autumn rains occur which enable farmers to grow crops such as rape and oats. Such cases and instances are somewhat rare, and those farmers who are specialising in the raising of very early lambs would undoubtedly find considerable benefits from the use of silage. In this connection it must be remembered that, weight for weight of dry material, silage is only equal to about one-third of that of hay. From the same crop 3 lbs. of silage is about equal in food value to 1 lb. of hay. Silage has the added advantage, however, in that it is succulent and laxative, and is also higher in vitamin content; 2 to 3 lbs. of silage per day forms a suitable amount for a sheep. It must be remembered, however, that cereal silage alone is low in protein and such material must be further supplemented with grain, such as oats or peas, to supply the requirements of the in-lamb or lambing ewe. Silage made from oats and peas or vetches results in

fodder higher in protein than that made from oats alone. It is to be hoped that more legumes will be incorporated in silage crops in this State.

Adequate fodder should always be provided for large stock. The supplementary food requirements of the horse for the year depends on size, the nature of the work and the number of days during the year the animal is working. For ordinary farm horses at heavy work a ration of 20-25 lbs. of chaff and 8-10 lbs. of oats should be provided daily. When the horse is not at work the grain portion can be eliminated and the chaff reduced. The ration can also be reduced where good green pasture is available at night.

Sufficient reserves of fodder are not only necessary to supply the needs of the stock during the normal year, but amounts above these requirements are advisable to guard against the losses which may result in adverse seasons. In seasons of late winter rains, poor nutritive conditions prevail for much longer periods than is to be expected in normal years. In the eastern wheat belt area this often amounts to drought conditions. In such areas poor growth of crops often results, and farmers are forced to cut large areas for hay for very small returns. If some reserves of fodder over the normal requirements had been conserved in good years, then crops which of necessity were cut for poor hay yields could have been harvested for more reasonable returns of grain. It is, of course, quite impossible for farmers to have sufficient conserved fodder to supply the requirements of several years, but it is essential that some reserves over their normal requirements should be available. Such additional supplies should be regarded as a form of livestock insurance against the effects of unfavourable seasons, which are experienced on occasions.

Oats v. Wheat.—Wheaten and oaten hay are very similar in food value, but the latter has a very definite place in wheat belt cropping rotations. Oats are very valuable for the control of Take-all and Flag Smut, two diseases of wheat which in many districts are the cause of serious losses. The grain is also very suitable for the feeding of practically all classes of farm stock. For these reasons oats should be used in preference to wheat for the production of farm fodders.

The following is suggested as a basis for arranging the reserves of fodder. Provision should be made, if possible, every season for—

1. Sufficient oaten hay or meadow hay to supply all the sheep at the rate of 1 lb. per head per day for four months.
2. Sufficient grain, such as oats, wheat or peas, to supply weaners and mated ewes with ½ lb. per head per day for a period of three months.
3. In districts where early lambs are being produced and no green feed is expected silage should be conserved to supply the ewes with a ration of 2 lbs. per head per day for three months.
4. Adequate fodder should be conserved for large stock. For horses at heavy work a ration of 20-25 lbs. of chaff and 8-10 lbs. of oats should be provided.
5. A reasonable carry-over above these requirements should be conserved to guard against the losses which occur when long dry summers and autumns and drought years are experienced.

CONCLUSION.

Suitable and adequate reserves are required for every year. Some measure of hand-feeding must form part of every good farmer's stock husbandry. The requirements of the particular stock must be considered when planning the year's requirements.

An attitude of caution should be adopted in arranging the hand-feeding programme. It is economic judiciously to allow the merino sheep (particularly wethers) to lose condition on a sub-maintenance diet. Hand-feeding to maintain sheep at their pre-summer level is uneconomic. Hand-feeding, however, should commence before the sheep become weak and poor in health.

Certain reserves are recommended. The successful farmer will be the one who has these reserves but only uses them when his good judgment and observations inform him that hand-feeding is necessary. This is good stock husbandry.

"C-U-L-L-I-N-G" SPELLS P-R-O-F-I-T.

SIMPLE POINTS FOR THE BEGINNER.

G. D. SHAW,
Poultry Adviser, Department of Agriculture.

There are five essentials to success in poultry farming:—

(1) Breeding from the best stock procurable.
(2) Hatching at the right time.
(3) Culling the pullets as early as possible.
(4) Continuous culling of the birds *as they cease profitable production.*
(5) Proper feeding methods.

Nos. 1 and 2 will be dealt with in later articles.

No. 5 has been dealt with in the Journal of the Department of Agriculture of Western Australia, Vol. XIII.—No. 4, Dec., 1936, pages 465-470.

Nos. 3 and 4 will now be dealt with under the heading of "Culling." Pullet culling must come first and then continuous culling receives the attention it deserves. The economic advantage gained by the farmer who realises the saving to be gained without loss of revenue by eliminating his dud pullets early, is so convincing that the farmer does not need to be impressed with the advantage of continuous culling. He continues culling automatically.

Culling is the practice of eliminating from a poultry farm all unprofitable birds so that the farmer may be able to receive a greater return for his labours by not feeding birds which may not be producing at all or may be producing an insufficient number of eggs to pay for feed, labour and accommodation.

For some years it has been the practice of the Poultry Branch to give demonstrations on culling to privately arranged meetings of poultry farmers, but recently we have found it expedient to advertise our demonstrations in the daily Press, and the success obtained has given fresh impetus to the teaching of this most important branch of poultry management.

To the uninitiated let me first explain that there is no mystery about culling the birds at night time. A hurricane lamp is sufficient light. The birds are quiet and no mistakes are made. It is not necessary to "check off" in the daylight.

"Culling" is a stock chapter in every poultry publication, but the average poultry farmer has not had the experience to interpret the phrases contained in those articles. It has been found during our demonstrations that the farmer is confused as to what is a "sunken eye" or a "bold eye," a "long beak" or a "short strong

beak," a "clean" face or a "dirty" face—in fact all those points written about with such freedom are so much foreign teaching to him. He wants the "personal touch" and in our demonstrations we hope to give that "personal touch" together with a logical reason for the explanation of every feature discussed. Unfortunately, all farmers cannot be reached personally, hence this endeavour to explain in simple language the different points necessary to judge the productivity of the farm flock.

The Economical Factor of "Culling."

Over a period of years we have found that the number of unprofitable producers being retained on the average poultry farm averages 33 per cent. of the total flock, including pullets and old hens. The percentage varies according to season, but it is astounding to notice how little the poultry farmer realises what an enormous loss is incurred by keeping those unprofitable birds.

It is no exaggeration to say that the poultry farmer is jealous of his stock—so jealous, in fact, that he will not comprehend that the flock of pullets reared to laying stage contains between 15 per cent. to 30 per cent. of birds which will be a loss mounting greater week by week if kept longer than is necessary for them to lay their first few eggs in March or April. These birds were never made to pay their way, yet because they have cost us 4s. 6d. each to rear to maturity we hesitate to market them. "They might lay a lot of eggs" is our only thought.

It should be the aim of the producer to have confidence in his culling activities and so have no hesitation in culling out those "potential profit eaters."

A common remark heard when one mentions "Culling" is that of "I must have 600 birds in order to make a living." In other words, 600 is considered necessary, no matter what are the qualifications to retention on the farm of any of those 600 hens.

The percentage of "duds" to date has been approximately 33 per cent. This figure is rough, it is agreed, but some culling results are hereunder:—

Farm No. 1, 1,500; culled out, 700; left, 800; no loss of production.
Farm No. 2, 2,500; culled out, 1,300; left, 1,200; no loss of production.
Farm No. 3, 1,100; culled out, 700; left, 400; no loss of production.
Farm No. 4, 600; culled out, 200; left, 400; no loss of production.
Farm No. 5, 550 (pullets only); culled out 180; left, 370; no loss of production.

The foregoing results give some idea of the class of stock held by farmers, and one does not wonder at the feelings of discontent within the industry. Whenever a dud fowl is kept, the profit from one good fowl is required to feed it.

In one farm where 600 were kept, the proportions were as follows:—200 duds requiring 200 fowls to keep them, leaving the balance of 200 fowls to keep the farmer. When the 200 duds were eliminated, the farmer gained another 200 birds for his own use and, besides, he then had less work to do.

It must be stressed that the dud needs keeping by someone and that someone is always the farmer who will persistently retain those birds which "might lay a lot of eggs." One can be quite confident in saying that, by eliminating the duds, the farmer will double his payable flock and be twice as well off.

Pullet Culling.

The 550 pullets on Farm No. 5 culled to 370 is another instance of the waste which is present in the average flock of pullets. Yet it is proved that the egg production from the 180 culled out was so low as to warrant their being sold to market immediately they reached maturity or before, if possible, if the farmer is sufficiently competent to judge—and some are.

Let it once be recognised that the most perfectly mated pen of birds does not produce 100 per cent. perfect progeny, and we then impress ourselves with the necessity of watching for the percentage of imperfect progeny.

The 550 pullets referred to above were from three well-known and competent breeders: they were fed and reared well and after culling the average production (whites and R.I.R.) for April was 169 eggs, May 204, June 207. First egg arrived March 20th. Two hundred eggs from 400 pullets in April, May and June pays well, but by retaining the 180 duds the owner would have had nearly 30s. per week less profit with 33 per cent. more work.

By continuous culling, those 370 now left (June) will be reduced to about 220 by March, 1938. Each bird must be "culled" out the moment it ceases profitable production. *You will then notice that to support 200 old hens through the moult, one must have 400 good laying pullets at 6 months old.* It can be readily understood that the preponderance in numbers of pullets to 1st year hens allows the producer to be making money when his 1st year hens are moulting.

In the past, one could always expect a farm to have 500 hens in the moult and perhaps less pullets just beginning to lay. The farmer then could not pay his feed bill, especially so as this proportion definitely acknowledges that the farmer *does not "cull."*

Deaths.

One always expects a big percentage of deaths in the pullet year. Even in our laying tests which contain picked birds, it can be as high as 16 per cent. How much greater must be the percentage on a farm of birds not specially selected.

When one gains confidence in culling pullets, one begins to notice how few deaths occur within the balance of the flock.

If we will understand that the poor producer is poorly constituted (and it always is), we can realise that if deaths are to occur at all, it should be amongst the poorly constituted birds, and by eliminating those unthrifty birds three months before they are going to die, one has a definite advantage thereby.

It is noticed that on all farms which cull the pullets severely, there are very few deaths through poor constitution and then less chance of spreading disease.

The advantages of culling are so enormous that one could write for pages—suffice it then to state than we save feed, save work, and save our flock against sickness. These three savings only should be sufficient inducement for following out the easiest of the branches of Poultry Husbandry.

Common Method of Culling.

Some of our best writers suggest culling seasonally, (a) as the pullets are growing, (b) in the moulting period, and (c) in the summer period. Some farmers follow this practice in principle but the respective details vary. The most common practice in Western Australia was (I say "was" because at present the system is definitely changing) (a) to cull out by yards as soon as the production dropped, and (b) to cull out at the moulting period, and (c) to sell all two-year hens when they had finished their second year's lay. If there were two yards containing 100 birds in each and No. 1 yard lays 30 and the No. 2 60 eggs per day, the farmer would market all the birds in No. 1 yard and retain yard No. 2. They would not endeavour to *find the 50 birds in yard No. 1 which were laying the 30 eggs* and retain them, and the *90 birds in No. 2 yard which were laying the 60 eggs* and

market the other 60 non-producers. No, they penalised 50 good hens because they unfortunately were the hard workers in a yard containing a lot of loafers. They sold the 100, 50 of which were good birds. They should have retained the 50 in No. 1 yard plus 90 in No. 2 yard, received 90 eggs, and sold the 50 duds in No. 1 yard plus 10 duds in No. 2 yard. Their farm would thereby be better stocked and more profitable.

Correct culling means the elimination of the bird immediately it reaches unprofitable production. A bird which may lay at the rate of one or two eggs a week when it takes 2 or 3 eggs per week respectively to pay should be eliminated.

You will find that by "culling" out the bird as it ceases profitable production your profits will increase rather than diminish; but by not culling, the profits diminish weekly.

Correct method:

To amplify the correct method of culling a flock, assuming a flock of 2,000 birds, each of which laid 200 eggs in 214 days (between April 1st and October 31st), and then ceased laying, and were not going to lay any further eggs for the next 242 days (until July 1st next year), we would not hesitate in selling the lot and living in idleness on the profits of the 214 days for those 242 days. Such then is an example of culling. We do have birds such as (b) or (c) below. So let us "cull" them out of the flock the moment they cease profitable production. (b) is culled out in December; we cannot afford to let that bird now eat into the profits at the rate of 10d. per month. (c) is culled out in November—we cannot afford 5s. 10d. for her feed. Keeping such birds is only a luxury enabling us to quote numbers—we want quality.

You should *cull* out a bird *the moment it ceases profitable production.*

If it needs three eggs per week to return a profit, cull out the bird which only lays two per week. Experience and observation over the past three years have definitely placed the number of "duds" in a pullet flock between 15 per cent. and 30 per cent. Again, the "sprinters," birds who lay well for a short period and then cease, can be put down at between 30 per cent. and 50 per cent. of the balance after the "duds" have been eliminated at 6 months old.

What do we mean by the classifications "Good," "Dud," "Sprinter" and "Fence Sitter"?

A "Good" layer is one which after commencing to lay profitably continues to do so for the full period of 12 months. A bird which each week of the year pays not only for its feed but returns a profit to its owner.

Illustration (a)—April 20, May 21, June 22, July 22, August 23, September 21, October 21, November 16, December 16, January 19, February 17, March 15. Total 233.

The "Dud" bird or poor producer is one which after having been carefully fed and managed for 6 to 7 months lays a few eggs—rests for two or three months and then continues in production but does not lay sufficient eggs each week of the year to pay for the feed of that week. It is usually a bird which may lay up to 30 or 20 eggs in March and April (some don't even do that). It rests in May and June, and will lay up to 7 eggs in July, 11 in August, 13 in September, 10 in October, 9 in November, 7 in December, and then stops. A direct loss each month! Why tolerate her? She may even lay 140 eggs in the year but that does not pay for her housing or keep.

Illustration (b)—April 3, May 4, June 7, July 8, August 8, September 14, October 19, November 12, December 1, January 9, February 0, March 0. Total 85.

The "Fence Sitter" is one which may or not be a "sprinter." It may lay a profitable production right throughout the year. Keep it.

The "Sprinter" is one of a class of birds which lay very profitably until November, December, January and February and may cease profitable production in either of those months. Cull her when she ceases profitable production.

Illustration (c)—April 19, May 21, June 29, July 21, August 25, September 27, October 24, November 19, December 18. Two hundred and three eggs in 275 days, then comparative idleness for six months.

Illustration (d)—April 20, May 20, June 22, July 23, August 24, September 26, October 22, November 17. One hundred and seventy-four eggs in 244 days, then comparative idleness for seven months.

One never should worry about the good bird or the fence sitter or sprinter—always look for the "dud." It is comparatively easy to spot the "dud" bird, and we do *not* suggest you should immediately send it to market after your first try. Keep it long enough to confirm your opinions. Take the hurricane lamp or torch at night and select the "dud" by comb texture only; you will confirm that 100 *per cent. of the hard "felt-like" combs have wedge-shaped bodies.*

Place all the "duds" in a separate yard and keep them until you are sure you cannot afford to keep them any longer.

Having thoroughly cleared your flock of "duds" you will be surprised to find some four or more weeks later one or more "duds" amongst your good birds. You will swear they must have been in a tree the night you culled, or better still, "They must have flown over from Jones's next door." You will eliminate them.

Again, you will find a few more "duds" and then it will dawn on you that those "duds" are not your neighbour's but your own "fence sitters" which have fallen off the "production fence" and taken on all the characteristics of the dud producer. They always do.

Both the sprinter and the fallen "fence sitter" over about eight weeks gradually show up like a "dud," from the time of ceasing *profitable* production. The comb hardens and the body contracts right upwards and handles accordingly "wedge shaped."

When one realises this transformation, one will anticipate its progress and close scrutiny in the future will spy out these falling idols at the moment they begin to fall. One will not wait until they finally break up. We then have learned to conserve all the profits and are now content. We are now continuously culling. The practice of culling by seasons is forgotten.

Let us now give you some idea of the progress of a flock from day-old pullets to the second moult at 30 months old. Born in 1935, 600 day-old pullet chicks will with reasonable care be 500 adult pullets in March, 1936.

We must impress upon the farmer that after rearing his 500 pullets to maturity, approximately 100 of them are "duds," *i.e.,* 100 of them will never lay enough eggs to pay for their feed. Cull out those 100 "duds," leaving 400 profitable pullets.

We then impress upon him that another 40 per cent. of the balance are sprinters, that is, they lay heavily for 6-9 months and then cease production altogether, *or cease profitable production.*

These 400 pullets now left will lay easily 55 per cent. eggs in April-May, when some will fall by the wayside. Cull out to 360—still getting 50 per cent. to 55 per cent. eggs in June; 60 per cent. July, 70 per cent. August to 85 per cent. September, 75 per cent. October.

Now you will find that few birds have been culled between July and October but what a drop in production occurs in November. The sprinters are losing their production—cull them out as they cease giving you a profit. Sixty per cent. production is then the percentage in November; cull continuously and December is 60 per cent., January 60 per cent., February 55 per cent. Your continuous culling, although it has certainly reduced your flock numbers, has also reduced your feed bill and work, but it has also allowed you to retain all the profits for yourself. You are making more money each week from the fewer in number but well culled out flock. We cannot afford to let a bird loaf on us for 5-7 months just to receive in return 7-5 months lay. It doesn't pay.

During April 1936 to March 1937 we will cull out 160 sprinters, leaving approximately 240 hens for the first moult (April 1937), at which period we have also 500 adult pullets.

We then cull out the 100 duds, leaving us 400 profitable pullets, so that our farm consists of 400 pullets just laying and 240 hens just moulting—a rather profitable combination. This idea has entirely reversed the existing process of having a flock of 50 to 50 pullets and hens.

It is very easy to calculate how the finances would be for a flock of 400 pullets averaging 17 dozen marketable eggs per day in April and May and 16 dozen daily in June. The average net price received this year, 1937, averaged all grades 1/7 per dozen. The cost of feed was 16/1 per 100 per week and the average number of birds was 240 hens and 400 to 360 pullets. Does culling pay?

You will notice that one must rear approximately 500 pullets yearly to have a farm of 240 hens 12 months later. Estimate on the basis of double the number of pullets reared each year to the number of hens desired to feed through the moult. Poultry farming then does pay.

All hens left after culling out heavily to March of the following year will be profitable for another period, but the farmer must continue with the same persistency, culling during the second laying season. For three or even five years he will still be able to find birds which will produce sufficient eggs in their four or six years to pay a handsome profit.

Normal Laying of an Unculled Flock of Pullets.

Let us imagine a picture of a flock of pullets beginning to lay.

They start off well and after about 4 or 5 weeks the production slumps. We then tell all our friends that the pullets are resting after their first pullet lay.

Why do we not realise that the dud pullet has laid all she is going to lay and will go into a neck moult, generally have a cold, and will not look "good" until about the middle of July.

Our flock then gives a steadily increasing number of eggs until the end of October, after which the production takes on a quick downward movement. Why will not we realise that the "sprinter" or "fence sitter" has decided to have a 6 to 8 months' rest?

If one culls the dud pullet after the first flush of lay and then watches closely for the "fence sitter" and "sprinter" to fall, the production will not fall in percentages but will increase to 85 per cent. in September and then the sudden decline is arrested by culling out that great number of sprinters and fence sitters who have by now decided to rest.

Such a practice of culling keeps the percentage production on an even figure. No percentage of lay should fall below 60 per cent. in October, November, December, January with about 55 per cent. in February.

LAYING CHARACTERISTICS.

When the baby pullet chick is born into this world its body contains an ovary which may have up to 3,500 possible yolks therein. Its body when growing during the 5½ months towards maturity grows according to the requirements of the bird.

A well-developed ovary and oviduct (that marvellous egg-manufacturing tube which may be as long as 22 inches) needs a fair-sized body to contain it.

Especially when that oviduct may also contain an egg 2 ounces in weight, ready to be passed out, and more eggs in the process of development, besides which the ovary is well developed, containing yolks of all sizes, some ready to drop, others nearly so, and big numbers in all stages of size and shape.

Consequently, if a bird has to have a big ovary, and a large oviduct containing large eggs, it must have *size or capacity*.

What, then, denotes *size or capacity?* Nothing more than Length, Breadth and Depth. All three are necessary.

It is admitted that the pullet rapidly develops to the point of maturity over a very short period. In other words, *her reproductive organs are not developing gradually during her first three or four months, but develop quickly.* It is also agreed that *the pullet is not going to have her bones forced apart to a greater distance than that required to encase those organs contained inside.* If these two statements are understood it must be agreed that the *depth and size of a pullet denote the requirements of the reproductive organs.* A deep bird—big reproductive organs; a shallow bird—small reproductive organs.

It is noticed also that the breast bone of the young growing pullet is not hardened, nor is she deep at the back, but when the reproductive organs are developing, the breast bone is then forced down at the rear end. *They are forced down by those reproductive organs to the depth or distance required by them to function.* For instance, if the bird is to be a good producer its organs naturally develop to the size necessary for the carrying on of that characteristic, and big space is required at the rear of the bird across the width of the back and great depth is necessary between breast bone and back bone. If the bird is a poor producer the organs are not as large, hence they need less space.

It must now be agreed that capacity—length, breadth, and depth—is necessary for a good producer of large eggs.

Sex.

Our utility strains are the White Leghorns, Australorps and Rhode Island Reds. They are distinct in characteristics, type and size, but they have one common factor. The sex characteristic is evident by the size and type of the comb. In experiments in other lands the opinions have been expressed that the texture of the comb of the male is related to vitality. A finely textured comb—a male of high degree of fertility and vitality; a coarse rough dry comb—a low degree of fertility and vitality. It is an accepted fact that fineness of comb is a great asset.

What of the female? Has her comb any relation to her reproductive functioning? Let us consider the moulting hen. Her comb has a dried-up appearance and feel. She is not laying, hence her comb changes in character and colour.

After handling birds for the last 17 years—10 years under trap nests and latterly by demonstration—one has no hesitation in saying that the comb has a definite relationshop to reproduction *and that the comb texture of the female is a definite indication of productivity.* A fine textured comb—a well developed set of reproductive organs. A dry, hard textured comb—a poorly developed set of reproductive organs.

This factor takes the mystery out of culling and allows the novice to operate on his own flocks confident of success.

Comb Texture.

GENERAL.

To tell the average poultry farmer that a bird must have fine comb texture is to speak to him in an unknown language. We must find something simpler. By using our own ear and also the rim of a felt hat we can obtain a very accurate gauge to comb texture.

If we feel the lobe of our ear -we can feel an inside condition; supple yet firm, pulpy yet strong, soft "inside" although it may be rough outside—such a "feel" of the comb of a hen or pullet will denote—"a fine texture."

Take your felt hat between finger and thumb and "feel" the inside texture of the rim, hard "inside," no give, no pulpiness, no body, only a tough hard condition.

These two conditions are quite definite and need no concentration to understand. A hard dry comb feels like a piece of felt hat. A full finely textured comb feels like the lobe of the human ear.

Pullet Comb Texture.

It must be thoroughly understood that the age of a bird has a marked influence on the "feel" of any comb. Let us liken it to the "feel" of felt. If a pullet is being handled the comb of the "dud" will feel like a piece of "new" felt hat, whilst the comb of the "dud" hen feels like a piece of old "felt" hat. These are the only varying factors in the feel of the comb. Many mistakes can be made if we forget to realise that the younger the pullet the more tender the feel even of the hard comb.

Comb Texture and Capacity.

We then interlock the comb texture with body capacity. A good producer has a fine textured comb, and has a big body capacity. A dud bird has a dry hard textured comb and has a small body capacity.

With the hard dry comb, no matter what its size may be, we will always have a small body and undeveloped (from the producing sense) reproductive organs. This latter has been proved correct in every case.

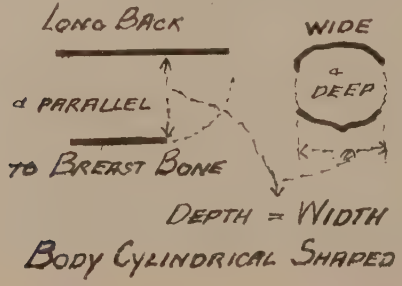
We have of course a fair range of comb texture between the "fine" and the "hard." This range is hard to interpret and *should not be considered by the novice—it is best forgotten. Concentrate on the "dud" bird,* the bird with the hard "felt"-like comb. The other types look after themselves.

This medium range contains the "fence sitters." They may be good layers or may only be "sprinters." They are mostly "sprinters."

This range of comb texture may be likened to the feel of the upper part of the human ear; harder than the bottom lobe yet showing a suppleness. The outside feel varies from rough to smooth but it is the inside "feel" which we are endeavouring to understand.

Classes:

We now have the following classes on our poultry farms:



Type.

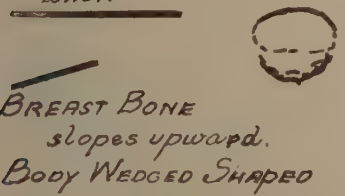
Good producer.

Comb Texture.

Fine, feels like the lobe of the human ear.

The good layer will have a body which is long, deep at front and the breast bone parallel to the back bone with a depth between back bone and breast bone equal to the width across the back. It does not taper up at the rear. The comb feels like the lobe of the human ear.

Good Bird—Note the hands showing that the back and breast bone are parallel.

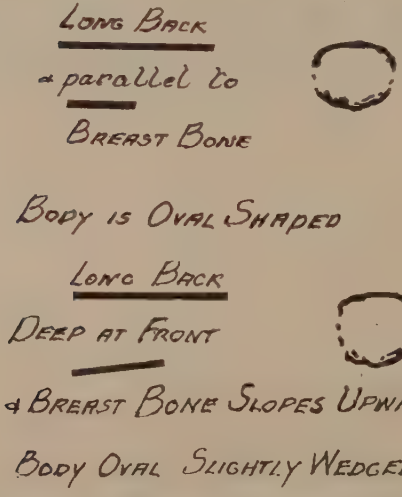


Type.
"Dud," bad producer.

Comb Texture.
Hard, feels like a piece of felt hat.

The dud bird always has a body which has no depth at the rear. It is wedge shaped. The breast bone is not parallel but comes up, so much so that by projecting its slope towards the rear one will find that it will meet a projection of the back bone at the point of the tail. The comb feels similar to the feel of the rim of a felt hat.

Dud Bird—Note the definite wedge-shaped body of the "Dud."



Fence Sitter.
Type "a."

Comb Texture.
Medium, feels like the top portion of the human ear.

Fence Sitter.
Type "b."

Comb Texture.
Medium, feels like the top portion of the human ear.

The fence sitter is the problem bird for the novice to understand. The comb texture is neither "hard" nor "fine" — between the two — and the body may be divided into the two shapes' classes:

(a) with a body having breast bone parallel to the back but not as deep as the width across the back; shaped like the ordinary quart wine bottle;

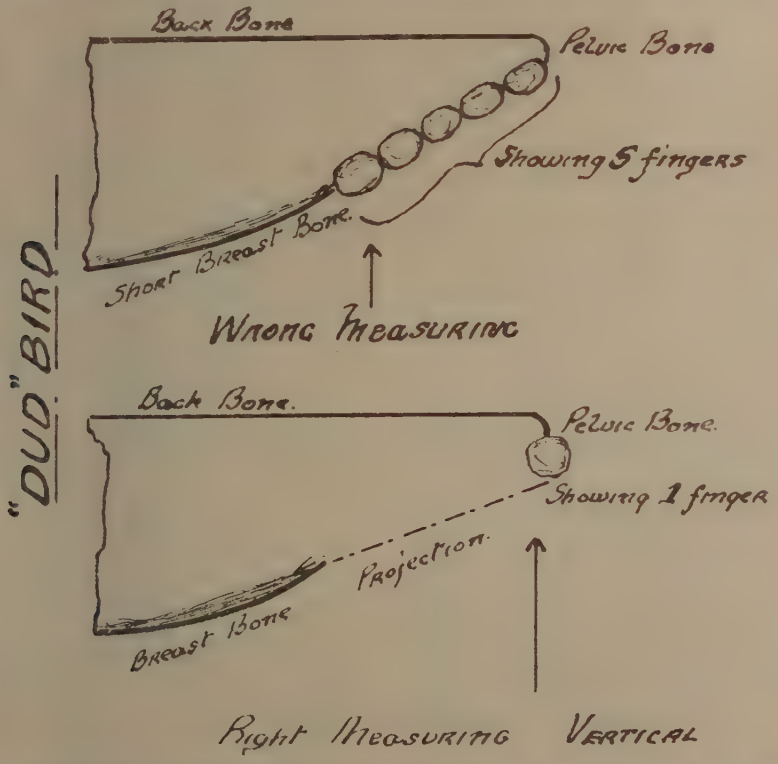
(b) with the body having correct depth at the front but with the breast bone tapering slightly upwards towards the rear but not sloping upwards sufficiently high, so that when projected it will meet the projection of the back bone at the point of the tail.

Measuring Capacity.

Many writers have told us that the measurements gauged by the finger distance between pelvic bones and back bones is a good guide to productivity. It is certainly a reliable guide to capacity as capacity does denote that the bird *should be* a good layer.

This unfortunate measurement gauge is so terribly mismanaged. Many a bird will measure the recognised 4 fingers. Some have been known to measure 6 fingers and not lay 60 eggs per year. We should know how to measure.

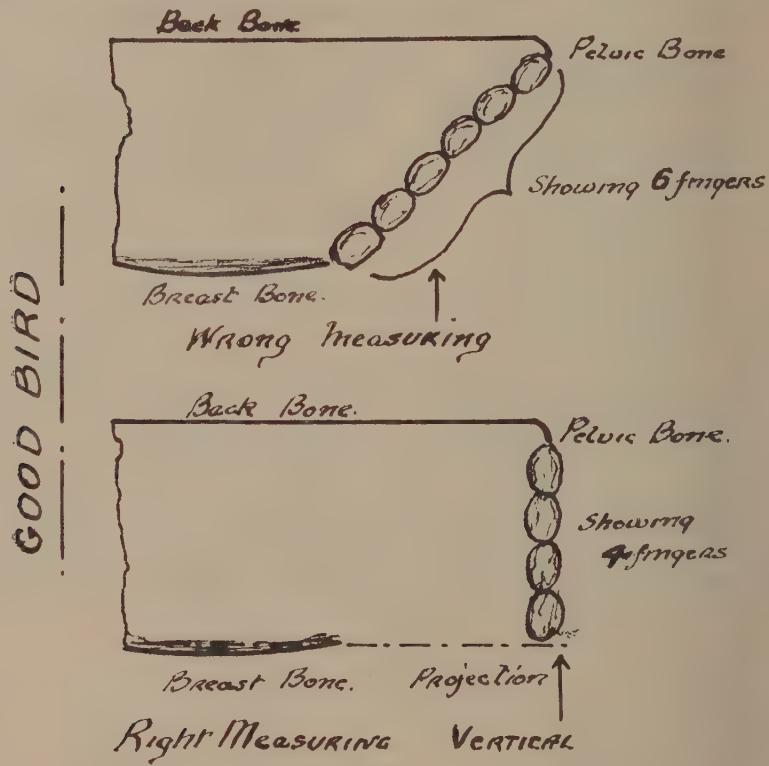
If the dud bird has a short breast bone, the measurement between the end of the bone being far distant from the pelvic bones gives a false gauge. One should always measure the distance between the projection of the breast bone and the pelvic bones, by using the measurement in an upright position, as shown below.



When holding a bird for measurement purposes the bird is resting on the palm of the left hand, the left elbow close to the side of the body. The head of the bird is facing the elbow of the left arm, with its two legs passing through and gripped by the fingers. The centre finger is held straight, bearing along the breast bone and projecting along the line of the bone towards the rear of the fowl.

The right hand is used for examination purposes.

The width of the bird is gauged by the distance between forefinger and thumb when such are spread across the back. A white leghorn should be approximately



5 inches across. The depth is estimated as equal to the width, and the length from the junction of the neck to body and to the tail bone is approximately one and a-half times the width.

THE MEASUREMENT OF HENS IN THE MOULT.

It will of course be understood that the moment the good producer (that is the bird that has laid profitably from March until March of the following year) is put into the moult and her reproductive organs are held out of production for that period of the moult, there is a slight change in the condition of the comb, and a slight contraction of the capacity between the breast-bone and the back. This contraction is due to the ceasing of production.

Therefore, when endeavouring to cull birds which are in the moult one should only cull those whose combs have gone into the definite "felt hat" feel. *All birds that have laid profitably for 12 months are not going to go through the moult without some small percentage breaking down*, and this small percentage is noticed by the condition of the comb texture. The moment this comb texture takes up the "felt hat" condition the body will also contract up to the wedge shape of the "dud."

Never look to comb colour, concentrate on texture, and the comb texture of a good bird going through the moult is similar still in feel to the lobe of the human ear. It may have a hard outside feel but it is the internal feel that we are considering.

The good bird that breaks down during the moult has ceased its period of profitable production. If one were to open the good bird going through a moult one would notice that the ovaries are still fully flushed and ready to function at the moment the drain of new feathering has ceased. Whereas if one opens the bird that, although it has laid profitably for 12 months, now has a comb which is hard similar to the "dud," one will find that the ovaries and oviduct are shrunken, showing only a small cluster of small unrecognisable future yolks. This shrinking out of production will naturally take a long while to recondition, whereas the good bird showing good texture through the moult is ready to drop her first egg at the moment she has reconditioned her feathering.

Pelvic Bones.

"The pelvic bones should be fine, pliable and well spread." This is another statement which is rather confusing to the average poultry farmer, and while the skilled breeder and "culler" will refer to these points in a final selection of a good pen, I am requesting the beginners to disregard the condition of these bones until they have negotiated the initial steps by discarding the dud on comb texture. The span of the pelvis is neither a definite indication of good laying nor of size of egg.

One will admit that the pelvic bones and pelvic span play an important part in defining whether a bird is *in lay*. But it does not define quantity and size. All the pliable pelvic bone denotes is that the bird is laying. But it may only be laying one egg per week—or less. This gauge is, therefore, useless in selecting the "dud"

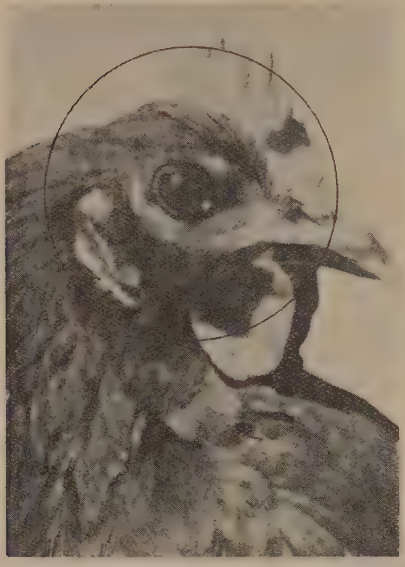
Head of Good Bird—Note the fine texture of comb with bold eye.

Head of Good Layer—Short strong beak and eye centre of furnishings.

layer. The width of pelvic span (*i.e.* distance between pelvic bones) has no bearing on size of egg, but one must agree that as size of egg needs capacity at the rear, it is found that most good big egg producers do have a wide pelvic span.

The pelvic bones can be a definite indication that the bird is out of production, but our aim is to discard any bird that ceases *profitable* production, and one egg a week is not profitable. *Comb texture is the definite indication.*

The pelvic bones can tell you that the bird is fat, but any superficial handling will show this factor especially when one feels between the pelvic bones and the breast bone.



Head of Dud—Long beak and hard felt comb.

Head of Dud. Note the hard felt-like comb and sunken eye.

Eye.

The bold, bright eye is also a definite symptom of a good bird; well set high in head.

Definitions.

Bold bright eye is one which projects outside the contour of the face which can be seen from the back prominently showing outwards, situated and projecting similarly to the portion and direction of our own human ear.

The sunken eye is one which, when viewed from the front, seems to project out from either side of the bird's beak in a similar situation to the position and angle of our own eyes. It will show a distinct cavity along the beak as if that cavity was needed in order to allow the bird to see forward.

Beak.

The bold, strong curved beak is one which shows strength and one which does not project outside a circle, the centre of which is the eye and which encircles all furnishings.

The long straight beak is one which seems elongated, or drawn forward as if it were sticking out looking for something, similar to the plant growing in a shady verandah stretched out towards the light. It projects outside a circle enclosing the furnishings.

WESTERN AUSTRALIAN F.A.Q. WHEAT.

L. W. SAMUEL[1]

and

G. E. DEAN[2]

I. ANALYSIS OF 1936-37 SEASON'S SAMPLE.

To determine the quality of the 1936-37 F.A.Q. wheat sample and to compare it with previous years, a sample obtained from the Chamber of Commerce was analysed and milled on the experimental mill in the Government Chemical Laboratory and the flour obtained was subjected to the standard baking test of the American Association of Cereal Chemists at the Department of Agriculture.

The mechanical and chemical analyses of the wheat are shown in Table 1, together with the data for the 1935-36 season's sample.

TABLE I.

Mechanical and Chemical Analyses of the F.A.Q. Wheat Samples for the 1935-36 *and the* 1936-37 *Seasons.*

	1935-36.	1936-37.
Moisture, per cent.	11.60	11.60
Bushel weight of clean grain, lbs.	63½	63½
Weight of 1,000 grains, gms.	39.13	38.67
Impurities, per cent.	0.7	0.6
Screenings, per cent.	2.1	2.6
Total millable grain, per cent.	97.2	96.8
*Protein (N x 5.83), per cent.	9.30	10.77
*Ash, per cent.	1.40	1.40
Pelshenke time, minutes	38	36

* On a standard moisture basis of 13.5 per cent.

Though the declared bushel weight was lower for the 1936-37 season the bushel weight of the clean grain was unchanged, but the percentage of millable grain is slightly lower than for the 1935-36 sample, due to an increase in the amount of screenings.

The protein content is definitely higher for the 1936-37 season, but the baking quality as judged by the Pelshenke time is not significantly different. The grain size as judged by the weight of a 1,000 grains has not altered appreciably.

In the experimental milling the wheat was cold-conditioned to 15.5 per cent. moisture and the flour obtained was separated into two portions. In the milling the first flours were bulked until approximately 60 per cent. of flour (calculated on the wheat) was obtained, this flour kept separate and then milling continued until the appearance of the bran and pollard was normal, the second flour so obtained was also kept separate. The sum of the first and second flours gives the total yield of flour. The object in separating the first (or patent) flour was to obtain for the baking test a flour more nearly comparable in grade with commercial flour. Only this patent flour was examined chemically and the results are shown in table II. which also contains the data for the 1935-36 season's sample.

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[1] Cereal Research Officer, Department of Agriculture.

[2] Chemist, Government Chemical Laboratory.

TABLE II.

Milling and Analytical Data for the Flour from the F.A.Q. Wheat Samples for the 1935-36 and 1936-37 Seasons.

Analyses on a standard moisture basis of 13.5 per cent.

	1935-36.	1936-37.
Yield—		
Patent flour, per cent.	63.5	63.3
Clear flour, per cent.	8.9	8.4
Total flour, per cent.	72.4	71.7
Pollard, per cent.	8.8	9.8
Bran, per cent.	18.8	18.5
Flour (patent)—		
Moisture, per cent.	13.05	12.76
Protein (N x 5.7), per cent.	8.24	9.61
Ash, per cent.	0.50	0.57
Wet gluten, per cent.	25.94	25.95
Dry gluten, per cent.	8.44	9.02
Water absorption, per cent.	51.0	52.5
Maltose figure (Kent-Jones)	1.73	1.64

The percentage extraction of the patent flour is practically the same for both samples and the difference in total flour extraction is not significant. The higher protein content of the 1936-37 season's wheat is reflected in the higher protein and dry gluten contents of the flour for this season. The ash content of the 1936-37 season's sample is high. The maltose figure is practically the same as for the previous season and falls within the range set by Dr. Kent-Jones for satisfactory gassing power. The water absorption is somewhat higher for the 1936-37 season's sample than for the 1935-36 season's.

The patent flour was subjected to the experimental baking test of the American Association of Cereal Chemists using hand mixing of the ingredients and the low form of baking tin. The basic formula and five supplementary formulae were used and the results are shown in table III. together with the results for the 1935-36 sample.

TABLE III.

Results of the Experimental Baking Test.

Baking formula.	Loaf No.	Loaf volume in mls. 1935-36.	Loaf volume in mls. 1936-37.
Basic formula	1	418	406
Basic formula plus potassium bromate	2	388	399
Basic formula plus malt extract	3	434	433
Basic formula plus potassium bromate and malt extract	4	401	392
Basic formula plus malt extract and mono-ammonium phosphate	5	447	444
Basic formula plus malt extract, potassium bromate, and mono-ammonium phosphate	6	412	414

There is no significant difference in the results for the two seasons considering any one baking formula. For this year as for last year there was a negative response to bromate (reduction in loaf volume) but the addition of malt extract and phosphate yielded a loaf significantly larger than the basic formula though not significantly larger than the loaf receiving malt extract only.

Because of the differences in diastatic activity (maltose figure) between commercially and experimentally milled flours it is not possible to state definitely that commercial flours would benefit from the addition of malt extract but in general, Australian flours are low in diastatic activity and do benefit from the addition of malt flour or malt extract.

Summary.

The 1936-37 F.A.Q. wheat sample is higher in protein content than the 1935-36 sample, and also higher than for the previous two seasons, but the quality as judged by the Pelshenke test and the baking test is the same as for the 1935-36 sample. The 1936-37 sample is superior however, in that the flour has a higher water absorption.

II. COMPARISON OF COMMERCIAL AND EXPERIMENTAL MILLING.

About 800lb. of the F.A.Q. wheat sample were milled commercially on a Tattersall Maxima mill through the courtesy of Messrs. M. G. Bond & Sons and the flour compared with the experimentally milled flour. Neither bleachers nor improvers were used in the commercial milling.

The chemical analyses of the two flours are shown in Table IV.

TABLE IV.

Analytical data for Flours milled commercially and experimentally from F.A.Q. Wheat.

Analyses on a standard moisture basis of 13.5 per cent.

	Experimental.	Commercial.
Moisture, per cent.	12.76	15.66
Protein (N x 5.7), per cent.	9.61	9.33
Gluten wet, per cent.	25.92	23.48
Gluten dry, per cent.	9.02	8.29
Ash, per cent.	0.57	0.51
Maltose figure, Kent-Jones	1.64	1.14
Water absorption, per cent.	52.5	52.0

For the commercial flour the moisture content is higher but the protein, gluten, ash and maltose are lower than for the experimental flour. The commercial flour was of superior colour, being of a better grade as shown by the ash content but the carotene contents of the two flours, as shown by a petrol extract, were practically identical.

The maltose figure for the commercial flour is below the standard set by Dr. Kent-Jones for satisfactory gassing power.

Contrary to the opinion generally expressed in the literature the experimentally milled flour had a higher diastatic activity than the commercially milled flour. The commercial flour has slightly the lower water absorption and it is of interest that for the experimentally milled flours from the 1935-36 and 1936-37 seasons and for the commercial flour from the 1936-37 season the water absorption is very closely related to the protein content.

The commercial flour also was baked experimentally by the standard A.A.C.C. method and in Table V. the results are compared with the results for the experimentally milled flour.

TABLE V.

Results of the Experimental Baking Test of Commercial and Experimentally Milled Flours.

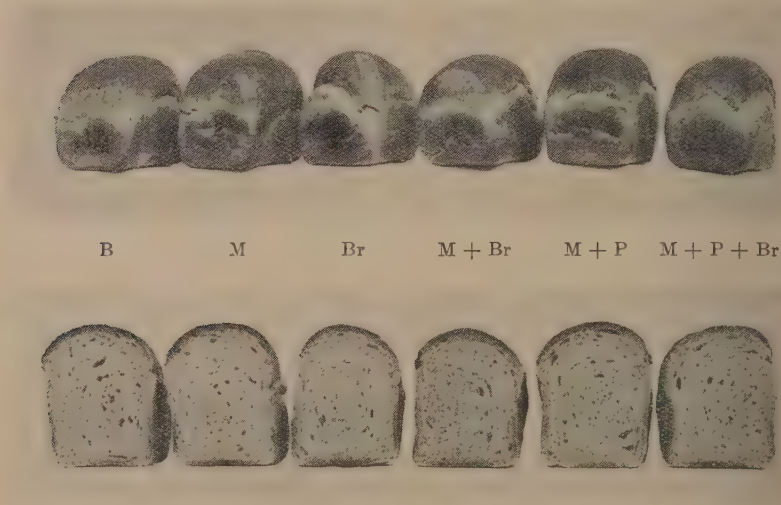
Baking formula.	Loaf volume (mls.) Experimental flour.	Loaf volume (mls.) Commercial flour.
Basic formula	406	491
Basic formula plus potassium bromate	399	489
Basic formula plus malt extract	433	492
Basic formula plus potassium bromate and malt extract	392	479
Basic formula plus malt extract and mono-ammonium phosphate	444	498
Basic formula plus potassium bromate, malt extract, and mono-ammonium phosphate	414	513

The commercial flour has shown no significant response in loaf volume to any of the various baking formulae, the expected response to malt extract not being obtained. Though the loaf volume was not affected by malt extract the crust colour of the loaf was greatly improved. The loaves from the experimentally milled flour are much inferior to those from the commercial flour in loaf volume and also much inferior in crumb colour, grain and texture.

Summary.

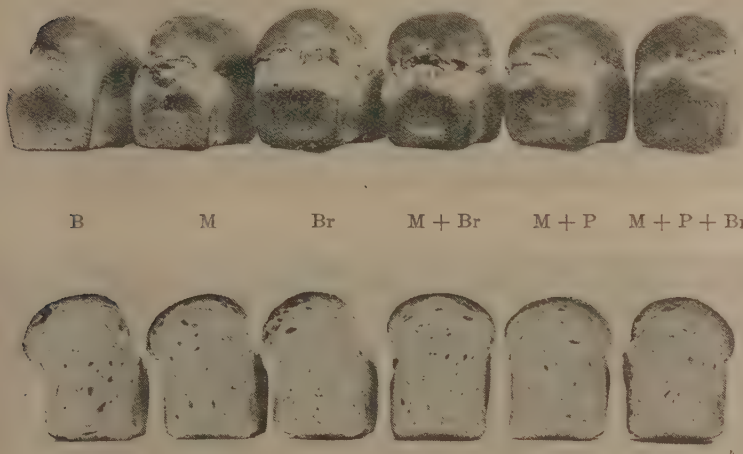
The flour milled commercially from the 1936-37 F.A.Q. sample was considerably superior in grade and baking quality to that milled experimentally.

The Experimental Baking Test with the Flour Milled Experimentally from the 1936-37 Season's F.A.Q. Wheat.



Loaf B—Basic formula.
M—Basic formula plus malt extract.
Br—Basic formula plus potassium bromate.
M + Br—Basic formula plus malt and bromate.
M + P—Basic formula plus malt and mono-ammonium phosphate.
M + P + Br—Basic formula plus malt, phosphate and bromate.

The Experimental Baking Test with the Flour Milled Commercially from the 1936-37 Season's F.A.Q. Wheat.



Loaf B—Basic formula.
M—Basic formula plus malt extract.
Br—Basic formula plus potassium bromate.
M + Br—Basic formula plus malt and bromate.
M + P—Basic formula plus malt and mono-ammonium phosphate.
M + P + Br—Basic formula plus malt, phosphate and bromate.

NOTES ON THE GROWTH OF CLOVER AND FIELD PEAS ON SOILS EXHIBITING MANGANESE DEFICIENCY IN CEREALS.

A. B. ADAMS, Muresk Agricultural College.

The occurrence of soils in Western Australian on which oats and wheat develop "white wilt" or "grey speck" disease has been proved by Carne (1) and Wild (2).

The disease commonly occurs on brownish ironstone gravelly soils which are generally powdery in texture, and the use of 14 lbs. of manganese sulphate per acre, in addition to the usual superphosphate dressing, is found to effect a cure. Evidence of the apparently normal growth of field peas and subterranean clover on these ironstone gravel soils which require manganese for satisfactory growth of wheat and oats, has been obtained on K. Adams & Sons' farm west of Northam. The portion of the farm affected originally carried white gum (Eucalyptus redunca, var. elata) and is typical of numerous patches in this belt of country between Northam and Tambellup. It was sown on fallow in May with "Ford" wheat (1 bushel per acre), White Brunswick Field Peas (1 bushel per acre) and Dwalganup Subterranean Clover (2 pounds per acre) by means of a grain and fertiliser drill. The fertiliser box was divided in halves by a central partition and one side was arranged to sow superphosphate and the other a mixture consisting of 90 lbs. of superphosphate and 14 lbs. of manganese sulphate at the rate of about 100 lbs. per acre.

The wheat on the super-only, half drill width, strips showed early evidence of "white wilt" and become more seriously affected as time progressed. By contrast

the peas and clover on the same strips flourished and showed no evidence of disease. Where manganese was applied with the superphosphate the wheat showed a beneficial effect soon after germination and made normal growth, giving the field the appearance of alternated strips of light and dark green. The peas and clover made similar growth under both treatments.

Figure I. shows the very poor crop of wheat (left) on the phosphate treated strip and the normal crop (right) where manganese as well as superphosphate was used. The estimated yield of wheat on the strips were: Phosphate only—1 bag per acre; phosphate and manganese—5 bags per acre.

While Samuel & Piper (3) have shown that peas and clover fail to grow in an entire absence of manganese it is evident that they will grow satisfactorily on soils on which cereals require manganese fertiliser. This is apparently due either to a lower requirement for manganese or a greater ability to secure it from manganese deficient soils in sufficient quantities to maintain health.

While it must not be thought that all white gum country in which the soil is of an ironstone gravelly nature is necessarily subject to "white wilt," it would be a good policy to try the effect of manganese superphosphate where cereals are unthrifty and show evidence of the disease. The mixed fertiliser may be obtained from the usual fertiliser companies and the effect in increasing crop yield frequently far more than compensates for the extra cost and brings into production soils which are otherwise unsatisfactory for cereal production.

The fact that peas and clover apparently grow normally on these soils where cereals are liable to fail suggests that these crops should be encouraged where liability to "white wilt" is known to exist.

References:

1. Grey Speck Disease of Wheat and Oats. W. M. Carne, Bulletin No. 227, Department of Agriculture, W.A.

2. Further experiments with Manganese as a Control of Grey Speck Disease in Western Australia. A. S. Wild, Journal of Agriculture, W.A., Vol II. (2nd series), p. 223.

3. Manganese as an Essential Element of Plant Growth. Geoffrey Samuel and E. S. Piper, Annals of Applied Biology, Vol. XVI., No. 4, 1929.

Fig. 1.—Thick crop on right of picture 14 lbs. manganese sulphate per acre. Thin crop on left no manganese.

TREE BALSAM OR GASCOYNE POISON.

(*Euphorbia eremophila* A. Cunn.)

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Acting Government Botanist.

The plant discussed in this article, *Euphorbia eremophila* A. Cunn., is known by many vernacular names, including "tree balsam," "milk weed" and "Gascoyne poison." In different districts these names are applied to entirely different plants, consequently the use of the botanical name is desirable in order to prevent confusion. Much of our knowledge concerning this species is based on circumstantial evidence, but the little experimental information secured in this State is in conformity. Tentative conclusions regarding its toxicity are largely founded on field observations, and for this reason I will recount the main incidents involved.

In the latter part of 1933, 57 bullocks and more than 1,000 sheep were lost on the stock route in the vicinity of Junga Creek, 35 miles from Cue. Mr. C. A. Gardner, Government Botanist, investigated this case and associated the deaths with two species of Euphorbia, viz. *E. Drummondii*, freqently know as "mat balsam," and *E. eremophila*. Again, in June, 1935, after a careful botanical survey, Mr. Gardner attributed the deaths of 150 cattle and 300 sheep on the Northern Stock Route at Meekatharra to *E. eremophila*. Over a period of many years heavy losses of stock have occurred in the Gascoyne district. At Jimba Jimba and Bidgemia as many as 2,000 sheep from flocks of less than 3,000 have been lost on two occasions. Pastoralists are in agreement that the deaths are due to plant poisoning, but many different plants have been suspected and there is no uniformity of opinion. During July of this year I made an inspection of the Gascoyne district, securing any information available from the pastoralists and stockmen, and paying particular attention to areas where losses had occurred. Sections of Jimba Jimba Station, where severe losses have been experienced, revealed an abundance of *E. eremophila* represented by two forms. Form (a) is taller, less robust and does not spread at the base to the same extent as form (b), which is depicted by the drawing. Later, gradations between these two forms were detected. Mr. Viveash recounted taking a flock through carefully along the Gascoyne River bed immediately following the loss of over 2,000 sheep which had been taken through the *E. eremophila* affected area. The plant does not grow normally in the sandy river bed and practically no fatalities were experienced.

The region where the stock route crosses the Gascoyne River, 10 miles East of Bidgemia homestead, is regarded as most dangerous and here large quantities of *E. eremophila*, along with *E. Drummondii*, were found; in fact, in sections the former was the dominant species of vegetation. Yankee Tank, 60 miles North of Carnarvon, the scene of trouble a few weeks before my arrival, provided a quantity of *E. eremophila*, which in parts was eaten practically to ground-level.

In every case circumstantial evidence strongly incriminated one or both species of *Euphorbia*, particularly as the incidence of other possibly doubtful plants, such as Native Fuchsia (*Eremophila maculata*), did not coincide with the losses experienced.

Experimental feeding of animals in the Eastern States with *E. eremophila* has given negative results, but Dr. H. W. Bennetts secured positive results with an aqueous extract of the plant prepared in Meekatharra and drenched to a sheep in Perth. The extract contained the equivalent of two pounds of plant material, and the result, with symptoms suggestive of cyanagenesis, was secured a short time after administration. Owing to the unstable nature of many glucosides, completely satisfactory tests cannot be expected until controlled experiments are conducted actually where the plants are growing. Arrangements are in progress for this work to be carried out in the Gascoyne district in the near future.

Euphorbia eremophila has a wide distribution, occurring in the dry interior of New South Wales and South Australia and in Western Australia extending from Ethel Creek to Mullewa and from the coast Eastwards to beyond Laverton, Practically the entire losses attributed to this plant are connected with travelling stock or animals which are new to the district, station sheep seldom being affected except under unusual circumstances as related below. Travelling flocks which have been hurried along during the day and arrive in a hungry condition at a camping place where *E. eremophila* or *E. Drummondii* is abundant is briefly the story of the heavy losses. An example of inducing similar conditions with station sheep was provided when, during shearing operations, a number of sheep were inadvertently kept in a yard for two days without feed. When released into a paddock where other sheep were grazing unharmed, deaths followed over-night. A quantity of *E. eremophila* was found in this paddock.

Most cyanogenetic plants show a considerable variation in toxicity under different conditions. This has been found to apply to *E. Drummondii* and is apparently also true of *E. eremophila*. No definite information in this regard is available, but observations would suggest that the re-growth following rain after a dry period has increased toxicity. Most serious effects are likely when large quantities of the plant are ingested during a short period of time. This feature is typical of a cyanogenetic species, the effects of which become marked when the rate of absorption of the poisonous principle exceeds that of excretion. Resting minimises the effect, and, if only mildly affected, many animals will recover completely when allowed to rest. These facts readily explain the contrast between experiences with station animals and travelling stock.

There is every reason for stock eating *E. eremophila*, as it is frequently green and succulent when most other herbage is dry. Its wide distribution and abundance renders eradication impossible and, although certain deviations of stock routes or construction of fenced "races" may be practicable in badly affected areas, the main counter at present is careful droving and the recognition of the plant by drovers. Animals should be allowed to graze en route, except where toxic species are abundant, and should not be hurried unduly. Exercise following ingestion of the plant merely accentuates the result, and water apparently has a similar effect. In the case of rams and small numbers of stud animals the cost of motor transport is well warranted.

Description of E. eremophila.—An annual or perennial plant of 6 inches to 2 feet in height, with mainly symmetrically branching stems. Leaves ½-2½ inches, long, narrow, usually with finely toothed margins, and leaving a gland-like scar when fallen. Small flower-heads (resembling single flowers) on short stalks in the axils of the upper leaves. Fruits three-angled, less than ¼ inch long.

Details of the plate.—The plate represents form (b), sometimes known as Jimba poison and suspected of being the most toxic form:—

A. Plant showing habit, × ½.
B. Leaf, × 1.
C. Fruit, × 2½.
D. Transverse section of fruit, × 4.
E. Flower head showing cup-shaped involucre and stalked ovary, × 5.

THE RHIZOCTONIA AND COMMON SCAB DISEASES OF POTATOES.

H. A. PITTMAN, B.A., B.Sc.Agr. (Hons.), Dip.Ed., Plant Pathologist.

INTRODUCTION.

According to the figures given by the Government Statistician in Part V. of the "Statistical Register of Western Australia," for the Seasons 1920-21 to 1935-36, both inclusive, the average annual area under potatoes in this State during this period was 4,782 acres, with an average yield over the whole period of 4.1 tons per acre.

The figures for the various seasons mentioned were as follows:—

Season.*	Acreage.	Yield.	Yield per acre in tons.
1920-21	4,245	13,368	3.1
1921-22	3,612	13,605	3.8
1922-23	3,621	15,198	4.2
1923-24	4,761	17,830	3.7
1924-25	5,122	19,891	3.9
1925-26	4,262	16,052	3.8
1926-27	5,144	17,755	3.5
1927-28	5,280	16,746	3.2
1928-29	4,819	18,774	3.9
1929-30	6,024	27,546	4.6
1930-31	6,306	26,318	4.2
1931-32	4,892	20,253	4.1
1932-33	4,971	22,309	4.5
1933-34	4,462	21,204	4.8
1934-35	4,050	19,162	4.7
1935-36	4,946	26,278	5.3
Grand Total— 1920-36 ..	76,517	312,289	
Average 1920-36	4,782	19,518	4.1

Although the average of 4.1 tons per acre represents the highest average yield of any State in the Commonwealth, there is no reason to suppose that this average cannot be increased if proper methods of disease prevention are more widely practised. This is borne out by the fact that the average yield obtained by growers using Government certified seed, since the inception of the Seed Certification Scheme, eleven years ago, as computed by Mr. E. T. Morgan, Officer-in-Charge of the Potato Branch of the Department of Agriculture, W.A., has been 8-10 tons per acre.

This is very largely due to the reduction of virus diseases in the process of producing the certified seed. In fact, the elimination of disease, in so far as may be humanly possible, constitutes the chief *raison d'être,* or justification, for the existence of the Seed Certification Scheme.

Up to date the highest yield recorded for Western Australia has been obtained by the use of such seed, and was at the rate of 23 tons 7 cwt. per acre, the same grower having taken 40 tons off two acres. Such yields are, of course, only obtained by a combination of the following factors:—

1. Suitable soils, localities, and times of planting.
2. Seed selection—preferably the use of Government-certified seed.
3. Seed disinfection before planting.
4. Racking of the tubers to secure sprouted seed, whenever possible.

*For the purpose of the statistical records, the season is taken as commencing on the 1st March in each year.

5. Elimination of all tubers on the racks showing "thready eye" or other undesirable characteristics.
6. Careful preparation of the soil, including adequate drainage.
7. Adequate manuring with well-balanced fertilizers.
8. Careful cultivation during the growth of the crop.
9. Intelligent use, when required, of spray mixtures or dusts to control such diseases as Early and Irish Blights, and also insect pests.

DISEASES.

The following diseases have been recorded on potatoes in this State:—

Name of Disease and Cause.

Rhizoctonia Scab, Stem Canker or Rosette—*Rhizoctonia solani.*

Common Scab—*Actinomyces scabies.*

Eelworm Scab—*Heterodera marioni* (*H. radicicola*).

Early Blight—*Macrosporium solani.*

Storage Disease—*Macrosporium solani.*

Fusarium Wilt—*Fusarium oxysporum.*

Bacterial Wilt, Brown Rot or Sore Eyes—*Bacillus solanacearum.*

Irish Blight—*Phytophthora infestans.*

Blackleg—*Bacillus atroseptieus.*

Mosaic—Ultramicroscopic parasite (virus).

Leaf-roll—Ultramicroscopic parasite (virus).

Streak—Ultramicroscopic parasite (virus).

Spotted or Bronzy Wilt—Ultramicroscopic parasite (virus).

Hollow Heart—Excessive rate of growth in coarse varieties.

Hot Formalin injury—Tubers left covered too long after treatment with hot formalin.

Fleck (Internal Brown Spot or Sprain)—A complex group. One form is caused by hot, drying winds during the ripening-off period of summer-dug potatoes on sandy soils.

1.—RHIZOCTONIA SCAB, ROSETTE OR STEM CANKER.

(Caused by *Corticium vagum* B. & C. = *Rhizoctonia solani,* Kuhn.)

Susceptible Plants.

This disease is the most widespread of all potato diseases, and it has been recorded from every part of the world where potatoes are grown commercially. The fungus responsible for the trouble is known scientifically by either of the two names given above. The first name is applied to the fungus when in the spore-forming condition, while the second name is that which is applied to the fungus in its much more common sterile condition. The perfect stage of the fungus has so far only been recorded in this State on infected tomato stems from Geraldton.

Many other plants beside the potato are attacked, and amongst those which have been recorded in various parts of the world are *beets, carrots, lucerne, red-clover, onion, raspberry, turnips, peas, celery, lettuce, beans, cabbage, carnations, parsnip, rhubarb, violets, egg-plants, radish, sweet potato, strawberry, tomato, and spinach. The fungus is a frequent cause of "damping-off" of seedlings.* In America, losses ranging from 5 to 50 per cent. of the potato crop in various districts have been recorded on account of the ravages of this parasite. In Western Australia

the disease has only become of serious moment during the past few years, as Herbert in 1920 stated that "*Rhizoctonia* is not common here though frequently found in imported potatoes."

Symptoms Shown by Affected Plants.

The disease is best known to the grower and to the general public as hard, sooty-black scabs or fungus-bodies on the surface of the tubers, which will not readily rub or wash off. These black bodies, which really represent resting stages in the life history of the fungus, are frequently very numerous and give the affected tubers the appearance of having been more or less thickly sprinkled with irregular drops of tar mixed with soil. (See Figs. 1 and 2.)

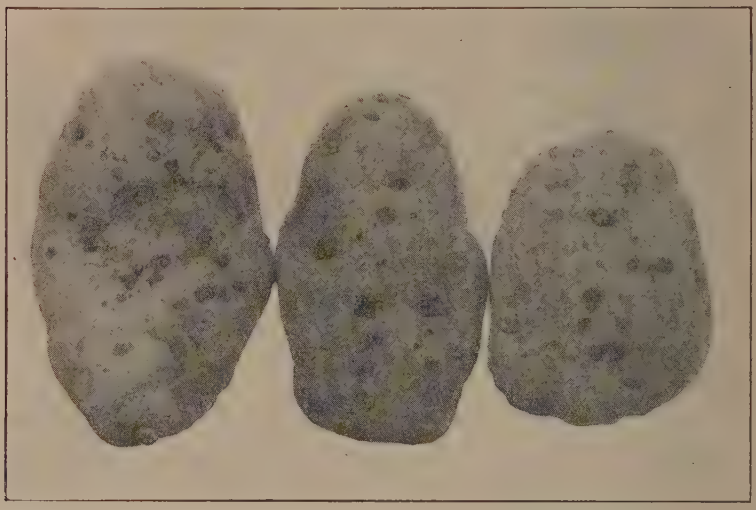

Fig. 1.—Potato tubers showing black *sclerotia* (resting bodies) of the fungus *Rhizoctonia solani.*

(*Photo. by Author from preserved specimens.*)

The black or brownish lumps are known as *sclerotia,* and may vary in size from mere pin-points up to huge structures occasionally covering an area of several square inches. As they do not penetrate the skin, they are in consequence removed when the tubers are peeled. Nevertheless, their presence is detrimental to the market value of the potatoes, as they considerably detract from their appearance. Their presence on seed tubers is, however, of far greater consequence than in the case of tubers sold merely to be consumed. When infected setts are planted the *sclerotia* give rise to colourless or brown fungus threads which work their way along the surface of the potatoes, or through the soil, to the young potato shoots and may proceed to attack them at the tips or else lower down, causing a dark brown or black canker (see Fig. 3). The affected shoots often throw out new buds lower down, and these may in turn be attacked. Such attacking and renewed growth may be repeated a number of times, until the sprout is finally killed altogether, resulting in a missing hill, or the plant may break feebly through the soil a long time after the healthy hills are up. In this way many of the shoots may be killed,

and a greatly reduced stand may result. *This constitutes one of the most serious aspects of the Rhizoctonia disease.* Reduction in stand is most commonly caused by *Rhizoctonia* in this State in potatoes planted in spring or autumn.

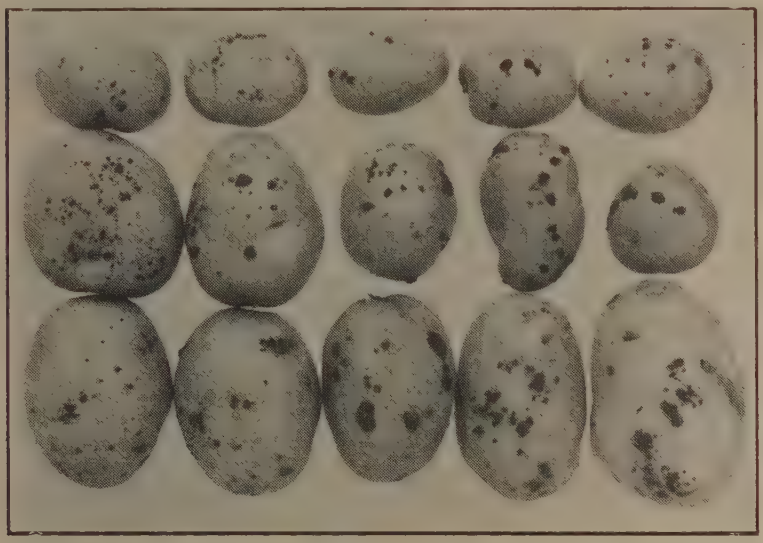

Fig. 2.—"Delaware" potato tubers showing the typical black or brownish resting bodies (*sclerotia*) of the fungus *Rhizoctonia solani.*
(*Photo by Author.*)

Rosetting and Aerial Tuber Formation.

If the base of the stem is not infected until the plant has gained considerable size, it may not be killed, but a shortening of the internodes at the growing point may result, as a consequence of the reduced water supply and food material reaching the growing tissues, and a massed or rosette effect may be given to the topmost leaves. These leaves may turn yellow or remain the normal green. Where the canker on the stem does not penetrate deeply enough to shut off or reduce the supply of water and dissolved minerals, but does penetrate deeply enough to interfere with the movement of sugars down to the tubers, there may result an accumulation of synthesised food materials in the top of the plant. In an endeavour to propagate itself, or at least find an outlet for this accumulation of food materials, tubers known as "aerial tubers" may be formed in the leaf axils on the above ground parts of the stems. (See Fig. 4.)

Stiffly Erect Attitude of Plants Attacked Late in the Season.

Potato plants, which are only attacked by *Rhizoctonia* when fairly well grown, can usually be picked out from a distance by their stiffly erect attitude, the yellowish colour of the foliage, and by the rolling up of the leaflets so that their somewhat lighter-coloured lower sides are rendered very conspicuous. Examination of the stems of such plants below ground level will reveal one or more characteristic brownish cankers more or less encircling the stems.

The canker phase of the disease on well-grown plants is of most serious moment in this State during the spring (in potatoes planted in June-July), and during the autumn (in potatoes planted in December-January). Deposition of

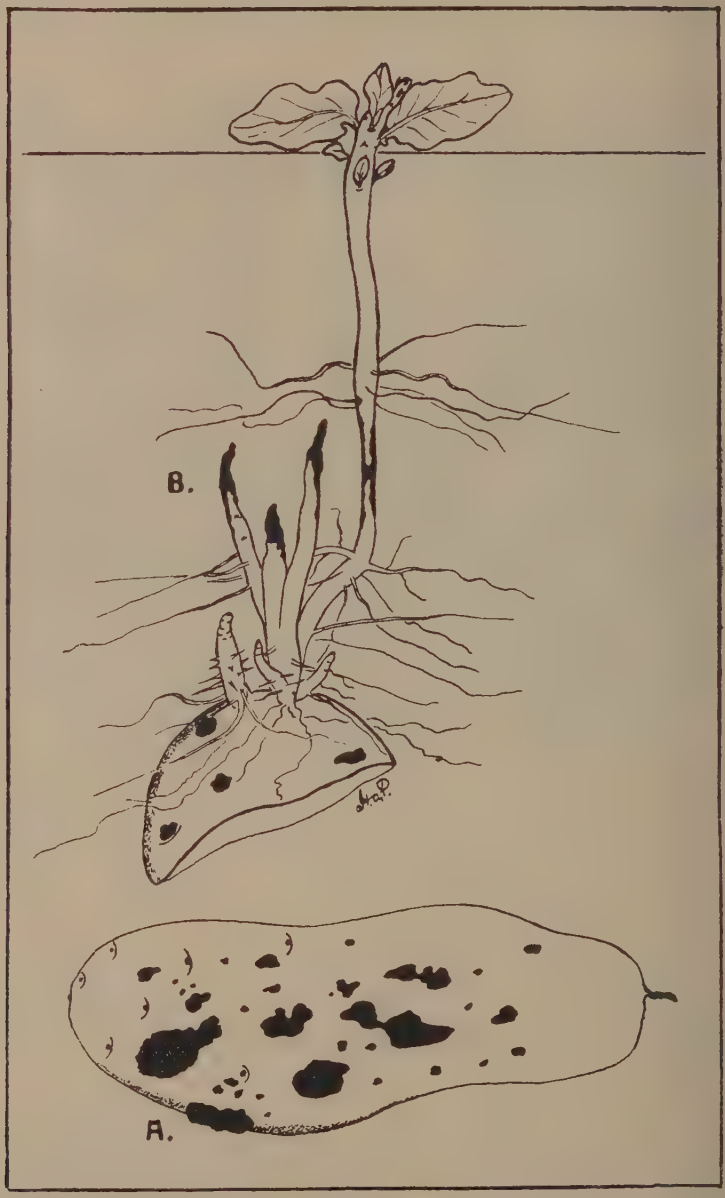

Fig. 3.—A.—Potato tuber showing many resting-bodies or *sclerotia* of the fungus *Rhizoctonia solani*, many being considerably larger than usually seen.

B.—Germinating sett showing the killing-back of the sprouts and cankering of the stem which may occur when tubers infected with *Rhizoctonia* are planted. *The resultant missing hills or sickly plants constitute one of the most serious aspects of the Rhizoctonia disease.*

The horizontal line beneath the expanding leaves represents soil level.

sclerotia on the surface of the tubers is apparently stimulated by falling temperatures, and the most thickly infested are those dug from the drained, peaty, swamps, in autumn.

In very wet weather the fungus may form a white cob-webby sheath of threads about the base of the stem. This is the reproductive stage of the fungus known as *Corticium vagum*. So far this stage has not been recorded in Western Australia on potatoes, but it has been seen on tomato plants from the Geraldton area.

General Considerations.

Rhizoctonia attack is greatly influenced by the environmental conditions. In this connection temperature often appears to be the most important factor. The temperatures at which the fungus does most injury are between 59-70deg. F. Other things being propitious, the fungus is most destructive at a soil temperature of 64deg. F. It thrives best in acid soils, and on this account liming gives good results in its control. Unfortunately the position is complicated by the fact that Common Scab (*Actinomyces scabies*) is *favoured* by liming, and so in avoiding *Rhizoctonia* in this way, one may encourage *Actinomyces*. In spite of the fact that acidity favours *Rhizoctonia*, heavy dressings of organic matter in the form of green manure considerably reduce the occurrence of the disease. Fortunately the same is true of *Actinomyces*. (*Actinomyces* is, however, *encouraged* by fresh *animal* manure.) In both cases the provision of abundant dead organic matter, in the form of green manure, seems to divert the unwanted attention of the parasites into other, more desirable, channels.

Control.

As *Rhizoctonia* is at present so very widespread, and as it may be present on the tubers as a fine, branched mass of threads which can only be detected by use of the microscope, all seed-tubers should be treated as if *Rhizoctonia* were definitely known to be present, and irrespective of whether or not they are certified.

The following measures are recommended for its control:—

1. Whenever possible, practise rotation of crops. This is one of the most effective means of controlling any plant disease. Cereal crops such as wheat, barley, oats, rye, maize and sorghum are not susceptible to Rhizoctonia attack. Susceptible crops (*see* commencement of article) should not be grown more frequently than is absolutely unavoidable in the same piece of ground.

2. Use only selected, Rhizoctonia-free, seed tubers, whenever possible.

3. If possible, avoid planting potatoes during the spring or autumn, especially on infected ground, or if the tubers have not been disinfected. In other words, if potatoes are to be planted at these times, the maximum care and attention in the direction of seed-disinfection and selection of "clean" land, etc., is required. Potatoes planted in spring or autumn suffer most from the "reduction-in-stand" phase of the Rhizoctonia disease.

4. Harvest as soon as mature in autumn-dug crops, in order to prevent rapid increase in the number of *sclerotia* on the surface of the tubers.

5. Plough in as much green manure as possible before potato crops.

6. Irrespective of their source of origin, and whether certified or not, disinfect all seed tubers before planting, in one of the following ways:—

A. *Cold Formalin Dip.*

Soak the tubers, unsprouted and uncut, for 1½ to 2 hours in a solution of formalin made up at the rate of 1 pint commercial formalin to 30 gallons of

Fig. 4.—"Delaware" potato plant showing "aerial tubers" in the axils of the leaves on the above-ground portions of the stem. These "aerial tubers" are a result of serious mechanical interference with the passage of "manufactured" food materials from the leaves to the underground portions of the plant. While frequently an indication of attack by *Rhizoctonia* they are by no means always so. Continued screwing about of the top of the plant by wind or attack of the stem by insect pests, etc., may have the same effect. The example illustrated was caused by slugs feeding on the stem about ground level, which is indicated on the photograph by the broken line.

(Photo by Author.)

water. If the tubers are washed, or dipped in water in the bags, and are kept moist for a day or two before treatment, the effectiveness of the disinfectant is increased and the soaking period in the formalin solution may be reduced to half an hour. The solution keeps its strength, but more solution should be added, as required, to keep up the volume to the original level. Tubers may be dipped in formalin solution in any sort of handy container, irrespective of the material of which it is composed. Formalin does not corrode metals, as does corrosive sublimate. At the end of the dipping period the tubers should be spread out thinly in a cool, shady place to dry. The cold formalin is not so effective as the others detailed below.

B. *Hot Formalin Dip.*

Soak the tubers, unsprouted and uncut, for three to four minutes, but no longer, in a solution of formalin, kept at a temperature of from 121deg. to 123deg. F., and made up at the rate of one pint commercial formalin to 15 gallons of water. After treatment the tubers should be immediately spread out thinly in a cool shady place to dry. *If this is not done, considerable pitting of the surface of the tubers may result.* The hot formalin solution may be used in metal containers without any danger of corrosion taking place. A supply of the solution, both hot and cold, should be at hand in order more readily to keep the correct temperature in the dipping tank. A carefully regulated fire may be used beneath the tank to keep the temperature around 122deg. F. The hot formalin dip is more effective than the cold in controlling any "seed"-borne potato disease.

C. *Cold Corrosive Sublimate.*

This is more effective than either of the formalin treatments for both *Rhizoctonia* and Common Scab.

Soak the tubers, unsprouted and uncut, for 1½ to 2 hours in wooden, earthenware, or cement containers (not metals) in a solution of corrosive sublimate made up at the rate of 4 ounces to every 25 gallons of water (*i.e.*, in a "1 in 1,000" solution). *See formula "f," Table* 1. The solution weakens with use, especially if much dirt is present on the surface of the tubers, or if the tubers are dipped in the bags, so that *one ounce of dissolved sublimate* (i.e., 1 *pint stock solution as per Table* 1) *should be added to each* 25 *gallons, after each lot has been treated.* Any water necessary to bring the volume up to the original level should also be added each time. *An entirely fresh solution should be prepared after treating four lots.* Each 25 gallons of solution treats about 5 bushels of tubers.

Dip the tubers in wooden crates, not bags, or else immerse directly into the barrel or vat, if provision has been made to drain the solution, by means of a bung hole in the side or bottom of the container, into another container after the treatment. The effectiveness of the treatment is increased by dipping the tubers in water, or by washing them, and keeping them moist for a day or two before treatment. If this is done the soaking period in the corrosive sublimate may be reduced to half an hour. Also, if the tubers are washed to remove dirt before dipping, and are not immersed in the bags, the solution may be used *six to eight times* before discarding, provided it is strengthened each time as described above. The temperature of the solution during treatment should be not less than 45deg. F. nor more than 70deg. F. If the temperature of the water is more than 70deg. F., the time of treatment must be reduced.

The tubers must be dried thoroughly after treatment by being thinly spread out on racks, etc., or the action of the poison will continue, and damage to the seed may result.

D. *Acidified Corrosive Sublimate Dip.*

This dip was originated some years ago by Dr. G. H. Cunningham, of New Zealand, as a means of controlling *Rhizoctonia*, and although it was not widely adopted in New Zealand it attracted considerable attention in the United States of America. Experiments carried out by the New South Wales Department of Agriculture have shown that it gives excellent results against both *Rhizoctonia* and Common Scab, and it is now recommended by that Department instead of the usual long-time dip.

To prepare 25 gallons of dipping solution, 4 ounces of corrosive sublimate are dissolved, by stirring, in 2 pints of commercial hydrochloric acid (muriatic acid), which are contained in a glass or glazed earthenware vessel. This gives a stock solution, which is then diluted with water in a wooden barrel or wooden vat, so that the final volume is 25 gallons.

The potatoes are dipped, unsprouted and uncut, into the diluted solution for *ten* (10) *minutes,* in a wooden crate which is made to fit snugly inside a large wooden barrel. A pulley block and tackle may be used to raise and lower the full crate. The potatoes must not be dipped in the bags. After treatment, the tubers must be spread out in a well-ventilated place to dry, and rapid drying is important or the eyes may be injured.

Dipping may be carried out some months before planting. Approximately 4 ounces of corrosive sublimate and 2 pints of commercial hydrochloric are required to treat one ton of seed tubers. The solution, prepared as above, may be used for ten dippings, as it loses its strength much more slowly than the ordinary non-acidulated dip. At the end of ten dippings, a further five dippings can be obtained from the one batch of solution, provided the time of immersion is increased to fifteen minutes in each case. At the end of this series, the dip should be discarded by pouring it into a hole in the ground and then covering over with soil.

Dipped tubers should on no account be eaten by human beings or be fed to stock. As the acid corrosive sublimate dip may cause irritation to the skin, it is advisable to rub the hands with fat before commencing dipping operations.

The acid corrosive sublimate dip has not been tested out as yet by this Department, but it comes to us with good reports from the Eastern States.

PREPARATION OF ORDINARY CORROSIVE SUBLIMATE SOLUTION FOR DISINFECTION OF POTATO TUBERS, ETC.

Stock Solutions Recommended.

Corrosive sublimate (mercuric chloride) is the chemical most commonly used for the disinfection of vegetable and flower-garden seeds, potato tubers, etc., the most frequently used formula being that known as "1 in 1,000." This means 1 part by weight of Corrosive Sublimate (Mercuric Chloride) to 1,000 parts by weight of water. In publications originating in the United States of America, the directions for making up this "1 in 1,000" strength are to dissolve the Corrosive Sublimate at the rate of 1 ounce in 7½ gallons of water. In British countries, however, the gallon measure used is larger that that used in the U.S.A., so that *the correct formula where using the Imperial gallon as a measure of volume is at the rate of corrosive sublimate* 1 *ounce avoirdupois in every* 6¼ *Imperial gallons of water* (*or* 4 *ounces to every* 25 *gallons*).

Where large quantities of Corrosive Sublimate solution are required, as in the disinfection of potato tubers or gladiolus corms, *the most convenient method of preparation is to make up a stock solution* **at the rate of one pound of finely-powdered sublimate in two gallons of hot water.** The poison may be dissolved by

carefully pouring the hot water over it in the bottom of a wooden, earthenware, glass or enamelled vessel. After cooling, the solution should be stored in a tightly-stoppered, clearly-labelled, glass or earthenware jar, etc., under lock and key, till required. **Metal containers must never be used for Corrosive Sublimate solutions, as they are corroded by the disinfectant.** The chemical only dissolves very slowly in cold water, so that hot water should be used whenever possible in making up the stock solutions.

TABLE I.

DILUTION TABLE FOR MAKING 1 IN 1,000 CORROSIVE SUBLIMATE SOLUTION, USING A STOCK SOLUTION OF **ONE LB. CORROSIVE SUBLIMATE IN TWO GALLONS OF WATER (OR HALF LB. IN ONE GALLON).**

Stock Solution. Take amount indicated below.	Amount of dissolved sublimate in quantity of stock solution taken.	Dilute with clean cold water in wooden, glass, cement or earthenware container to final volume indicated below.
(a) ¼ pint	¼ ounce	1 gallon 4½ pints
(b) ½ ,,	½ ,,	3 gallons 1 pint
(c) ¾ ,,	¾ ,,	4 ,, 5½ pints
(d) 1 ,,	1 ,,	6 ,, 2 ,,
(e) 1 quart	2 ounces	12 ,, 4 ,,
(f) ½ gallon	4 ,,	25 ,,
(g) 1 ,,	8 ,,	50 ,,
(h) 2 gallons	1 lb.	100 ,,

Weaker Stock Solution.

In cases where it is anticipated that only very little of the disinfectant will be required, a more convenient stock solution may be prepared by dissolving *½ ounce* of Sublimate in *one quart* of hot water (or *two ounces in one gallon*) by the same method as indicated above. For use this second stock solution is diluted as follows:.

TABLE II.

DILUTION TABLE FOR MAKING 1 IN 1,000 CORROSIVE SUBLIMATE, USING A STOCK SOLUTION OF **ONE HALF OUNCE (½ oz.) IN ONE QUART OF WATER (OR TWO OUNCES IN ONE GALLON.)**

Stock Solution. Take amount indicated below.	Amount of dissolved sublimate in quantity of stock solution taken.	Dilute with clean cold water in wooden, glass, cement or earthenware container to final volume indicated below.
(a) ¼ pint	1/16th ounce	3½ pints
(b) ½ ,,	1/8th ,,	6½ ,,
(c) ¾ ,,	3/16ths ,,	1 gallon 1⅜ pints
(d) 1 ,,	¼ ,,	1 ,, 4½ ,,
(e) 1½pints	5/8ths ,,	2 gallons 2⅞ ,,
(f) 1 quart	½ ,,	3 ,, 1 ,,
(g) ½ gallon	1 ,,	6 ,, 2 ,,
(h) 1 ,,	2 ounces	12½ ,,

Labelling of Stock Solutions and Warning.

The strengths of all stock solutions should be written on the labels as soon as the solutions are prepared, and it would be just as well also to include a copy of the appropriate dilution table on the same or a separate label on the container.

Mercuric Chloride (Corrosive Sublimate) is deadly poisonous to human, animal or plant life. In addition, it is colourless, odourless, and comparatively tasteless, and may easily be mistaken in solution for pure water. It should therefore be used with great care and kept out of the reach of children or farm stock. When finished with, the solution should be poured into a hole in the ground, and the hole be immediately filled in or covered over. In case of mer-

curic chloride poisoning give whites and yolks of eggs mixed with milk. In emergency, ordinary flour paste may be used. Then give a mustard emetic to induce vomiting and send immediately for medical assistance.

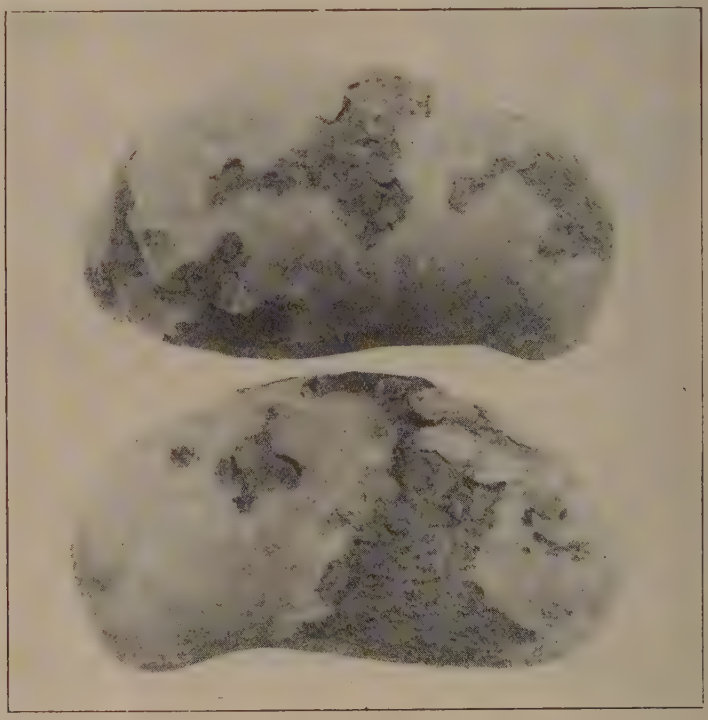

Fig. 5.—Common Scab of potatoes due to *Actinomyces scabies*, showing both sides of the one tuber badly affected.
(*Photo. by Author.*)

2.—COMMON SCAB.

(Caused by *Actinomyces scabies* (Thax.), Güssow.)

Plants Susceptible.—This disease is found not only on the potato, but has also been recorded by various observers on *beetroot, white turnips, mangels, rutabagas (swede turnips), parsnips, radishes and carrots, amongst others.* On potato, the disease is fairly common in Western Australia in certain districts, and especially so where the tubers are grown on soil which has been rendered somewhat alkaline by liming, or in any other way, such as by the burning-off of the native vegetation. It is often very serious in drained peaty swamps containing a high percentage of lime in the form, for example, of shells of dead molluscs.

Symptoms.—In typical cases this disease can be readily distinguished from eelworm-scab, which is the only other disease present in this State with which it could possibly be confused. The disease is characterised by the presence of roughened and fissured corky areas on the surface, which contrast strongly with the smooth, lighter-coloured, unaffected neighbouring tissue (see Fig. 5). When isolated the diseased areas are generally approximately cylindrical, and they

usually show a small series of more or less concentric corky ridges and corresponding fissures. The margins of the lesions are generally ridged up above the level of the surrounding healthy skin (see Fig. 6). Only a single lesion may occur on a tuber, but more commonly there are several, and occasionally there may be so many that it is difficult to find an area of unaffected skin. The lesions commence as small rusty-brown specks at the breathing pores or lenticels. From these positions they gradually work outwards, and in the course of time may coalesce and form areas of very great extent (see Figs. 5 and 7). In bad cases the whole surface

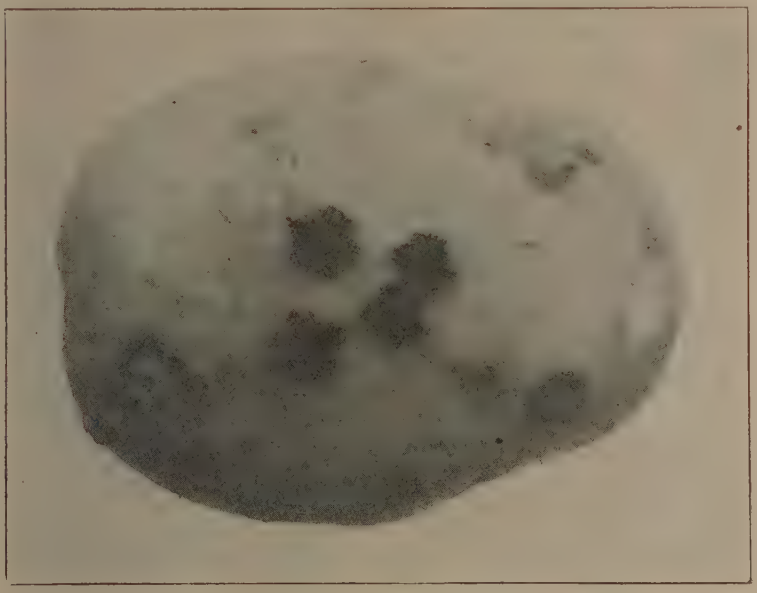

Fig. 6.—"Delaware" potato tuber showing several approximately circular Common Scab lesions which have begun at *lenticels* (breathing-pores) and are gradually extending in area.

(*Photo. by Author.*)

of the tuber may be covered with lesions. Secondary organisms frequently then take control and may soon reduce the tuber to a disintegrating rotten mass. On being dug up, potatoes affected with Common Scab frequently show a very delicate whitish film of *Actinomyces* covering the diseased areas. This very quickly dries up and disappears on exposure to air and light.

Three Types of Lesions.

Common Scab lesions may be elevated above the general surface of the tuber in the form of warts or blisters, having the outward appearance of eelworm-galls, or they may be nearly on a level with the remainder of the potato skin, or again they may be deeply depressed.

Cause.—This disease is due to a bacterial parasite called *Actinomyces scabies.* The organism is peculiar in that the genus to which it belongs consists of bacteria which form long, thread-like, multi-cellular filaments, which suggest the *hyphae* or threads of the higher fungi. These threads very readily break up, however,

into normal, unicellular, rod-like bacteria. These are able to live on the organic matter in the soil as well as on the surface of the potato tubers and the underground parts of certain other plants. (*See* section of article dealing with susceptible plants.)

General Considerations.

Actinomyces scabies is greatly stimulated by the addition to the soil of lime, wood ashes, nitrate of soda, or any material which will tend to render the soil alkaline. It is for this reason that potatoes following cabbages or other crucifers, which have been heavily limed for the control of Clubroot (*Plasmodiophora brassicae*), are often badly affected with Common Scab. Acidity is unfavourable to its development, and therefore the use of acid fertilisers such as superphosphate, sulphate of potash and sulphate of ammonia will tend to reduce the disease. As

Fig. 7.—Common Scab due to *Actinomyces scabies* on both halves of each of two "Delaware" potatoes grown on a drained peaty swamp rich in lime.

(*Photo. by Author.*)

nitrate of soda, if used for a considerable period, tends to render the soil reaction alkaline, it should not be used where Common Scab is likely to be in evidence. It is unfortunate that alkalinity is favourable to Common Scab, because by increasing the soil acidity to reduce attack by *Actinomyces*, the effect is to encourage *Rhizoctonia*. It has been shown, however, that attacks by both *Actinomyces* and *Rhizoctonia* are reduced by increasing the organic matter of the soil in the form of green manure crops which have been ploughed under. The grower therefore should make every effort to increase the humus content of the soil by the incorporation of green manures, if his soil is at all deficient in organic matter.

Common Scab is most serious where the soil temperatures are high. It has been shown that it does most damage—other things being favourable to it—at a soil temperature of about 68-77deg. F. The range of development of the disease is given by Jones, McKinney and Fellows as from 11 to 30.5deg. C. (51.8 to 86.9 deg. F.) with but slight infections at either extreme. In certain field trials 77deg. F. was the most favourable temperature for scab development. Low moisture content favours the disease, **so that scab is most serious under a combination of soil alkalinity, high soil temperature and low soil moisture.**

Control.

1. If the soil is badly infested with *Actinomyces*, rotate with other non-susceptible crops. Grasses, cereals or clovers could be used in rotations with good results. Do not use root crops in rotations. A susceptible crop should not be used more frequently than every fourth year on the same piece of ground.

2. Use clean seed whenever possible. "Avoid the use of badly scabbed tubers for seed, as they will always produce more scab than clean seed, even when given a standard seed treatment." (Heald.)

3. No matter what the source of origin, and whether they are certified or not, treat all seed tubers with formalin or corrosive sublimate (mercuric chloride) as recommended above for the control of *Rhizoctonia*.

4. Substances tending to cause soil alkalinity such as lime or wood ashes should not be applied to the soil immediately before growing a potato crop. If they must be used, they should be applied to other crops preceding the potato crop by as long a period as possible.

5. Every attempt should be made on soils at all deficient in organic matter to increase the humus content and the acidity of the soil by the ploughing-in of green manure crops.

6. Avoid using nitrate of soda as it tends to increase the soil alkalinity. Use sulphate of ammonia or blood and bone instead as sources of nitrogen.

As indicating the effect of acidity in reducing the amount of Common Scab, it is interesting to note that in certain parts of America, where potatoes are very often grown for many years without a change of crop, the harrowing-in of from 300 to 450 pounds of "inoculated" sulphur before the potatoes are planted has given good control. This treatment has not been tried out in Western Australia, and no recommendation can be made concerning it.

7. Keep up the moisture content of the soil by irrigation, etc., where practicable, on soils inclined to dry out during the summer.

8. Do not feed uncooked scabby tubers or peelings to animals, and avoid dumping scabby tubers or peelings on the compost heap or fields.

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Herbert, D. A., "The Potato—Its Diseases." In Bull. No. 72, Dept. Agr., W.A., 1920.
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SUBTERRANEAN CLOVER SEED CERTIFICATION.

Increase of Scope During the Coming Season.

In response to requests from producers and merchants, the Department has extended the Government seed certification scheme to include the mid-season strain as well as the early (Dwalganup) strain of subterranean clover. This extension will commence operating during the coming season.

THE TOBACCO-CURING BARN.

A. SHARP, U.D.A., Tobacco Adviser

INTRODUCTORY.

There is a steadily increasing demand in Australia at present for tobacco of light colour and mild smoking quality, whilst the heavier and darker types are going out of favour. As a result of this demand, the tobacco leaf for which the highest prices are being paid by the manufacturers is the bright yellow, flue-cured type. To obtain as high a proportion as possible of leaf which will grade lemon and bright mahogany is therefore the object of the tobacco grower.

In the production of this type of leaf, a number of factors play an important part. These include the selection of suitable soil, the growing of suitable varieties, sound methods of cultivation, and last, but by no means least, efficient curing of the ripe leaf.

It is sometimes argued that really good tobacco leaf is extremely easy to cure, and that almost any old shack will serve as a curing barn. It is true that leaf which has been allowed to mature thoroughly on the plant under ideal climatic conditions may cure very satisfactorily in a somewhat crudely constructed kiln in the hands of an expert curer, but, unfortunately, much of the leaf grown in Australia ripens under conditions which are rather too hot and dry to be ideal. Consequently much care and judgment have to be exercised by the curer if satisfactory results are to be obtained. No known method of curing, of course, will convert poor or immature leaf into good leaf, but good curing, carried out in a well designed barn, will further develop and fix the desirable qualities inherent in properly grown leaf.

During the curing process, certain chemical changes take place in the leaf, these being normally accompanied by a change of colour from green to yellow. The art of curing lies in regulating the temperature and humidity of the atmosphere surrounding the leaf so that, just as the web reaches the desired colour, sufficient moisture has been extracted to kill it and thus prevent any further chemical action which would cause the leaf to turn dark. It follows, then, that the ideal curing barn is one in which the atmospheric temperature and humidity can be regulated within reasonably close limits, irrespective of the atmospheric conditions obtaining outside the barn.

THE MODERN FLUE-CURING BARN.

In the modern flue-curing barn the temperature is regulated by a heating system consisting of one or two brick furnaces connected to a series of sheet iron flue pipes running across the floor, and exhausting into one or two chimneys. To assist in the conservation of heat, and to avoid sudden fluctuations of temperature due to outside weather conditions, the walls and roof are built of some material which is a good insulator of heat. The degree of humidity is regulated by adjustable ventilators at ground level and in the roof.

Until two or three years ago, the curing barns in use in this State were somewhat crudely designed and built, and there is little doubt that this fact, together with the comparative inexperience of many of the growers, was responsible for the inferior colour and smoking quality of much of our leaf. Since the Commonwealth grant to assist in tobacco investigation work was instituted in 1934, however, considerable progress has been made in developing a type of curing barn suitable for use in this State.

LOCALLY-DESIGNED CURING KILN.

The writer took the opportunity while in the Eastern States in 1935 and 1936 to investigate the question of curing barn design. A large number of kilns, of various types, were inspected in North-East Victoria, at Ashford, N.S.W., and in a number of districts in Queensland, and their merits and demerits discussed with various tobacco experts and growers. The information thus acquired was put to practical use during the summer of 1936-37, when the writer designed and built an experimental kiln on the property of Mr. G. F. Combs, at Jardee. A series of curing experiments was conducted in this barn during the season, and it was found to be easy to operate, very economical in firewood, and superior in every way to the older types in common use in this State. A number of growers, including Mr. Combs, built barns of similar design, and in every case have expressed satisfaction with the results obtained. As a result of the experience gained with this barn, together with close observation of the behaviour of a number of others of various types and sizes, the following notes are offered as a guide to those contemplating the erection of curing barns.

Fig. 1.—Tobacco-curing Kiln erected to the writer's design at Manjimup for experimental work by the Dept. of Agriculture into the techniques of tobacco curing.

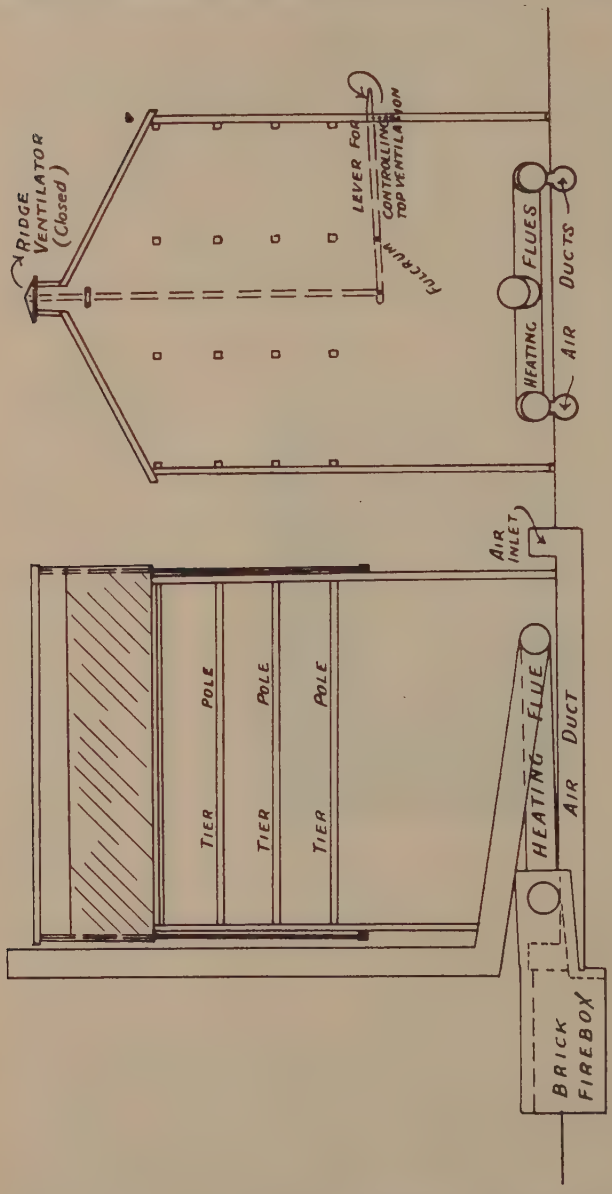
Photo. by Author.

SIZE OF BARNS.

The size of barn which will be found most convenient will depend largely on the area of crop to be cured and the amount of labour available. In this State, most of the tobacco plantations are comparatively small, usually from 5 to 15 acres, and rarely exceeding 25 acres. For small plantations, say, up to 15 acres, a number of small barns, each 12 ft. by 12 ft. inside measurement, and carrying four tiers of leaf, will be found most suitable. For areas greater than 15 acres, barns 16 ft. by 16 ft. with four or five tiers may be used.

The writer is very definitely in favour of the small barn. It is essential for good results that the curing process should start within a few hours of the leaf

being picked, and the small staff which can be economically employed on the small plantation can fill the smaller size barn comfortably in one day, whereas two or more days would be required to fill the larger size. It is frequently found, also,



— SIDE SECTION — — SECTIONAL ELEVATION —

— 12' x 12' CURING BARN —

— Fig 2. — — Fig 3. —

Figs. 2 and 3. Drawings showing side section and sectional elevation, respectively, of open-ridge-ventilator type of 12ft. x 12ft. tobacco-curing kiln. For description of construction, etc., see text.

that two or more distinct types of leaf may be grown on one plantation owing to variation in the soil or some other factor. These different types usually require different treatment during curing. Where small barns are provided they can be

cured separately, thus enabling each to receive any particular modification of the curing process which it may require. In order to fill a large barn from a small area of crop, the grower is frequently tempted to harvest leaf which is slightly immature, a practice which cannot be too strongly condemned. Immature leaf will not cure properly and is unsaleable. Where several small barns are provided, picking can be done more frequently, thus permitting of a more evenly matured sample of leaf.

Generally speaking, one 12 ft. by 12 ft. barn will be sufficient for each four acres of crop, while a 16 ft. by 16 ft. barn will deal with each seven acres. While the capital cost of a number of small barns is greater than that of a smaller number of larger units having the same aggregate capacity, the higher proportion of bright leaf obtainable by the use of the former will more than repay the extra outlay.

SITE FOR THE CURING KILNS.

The barns should preferably be built in a fairly well sheltered position on slightly sloping ground, the furnaces being built on the lower side in order to lessen the amount of excavation necessary The accompanying sketches show the construction of a 12ft. by 12ft. barn to hold four tiers of leaf. A 16ft. by 16ft. barn would be built on precisely similar lines except for the arrangement of furnaces and flues.

MATERIALS.

Various materials may be used in the construction of the barn. The framing should consist of 4 in. x 2 in. jarrah, with wall studs set at 2 ft. centres. This may be lined with either wood, corrugated iron, asbestos-cement sheets, or fertiliser or wheat bags (not necessarily new) sewn together and treated with cement wash. The last named is the cheapest, and is regarded by the writer as more or less a makeshift, but it is very largely used in this State at present, and, where double-bag walls well coated with a suitable cement wash have been used, good results have been obtained.

FORMULA FOR CEMENT WASH.

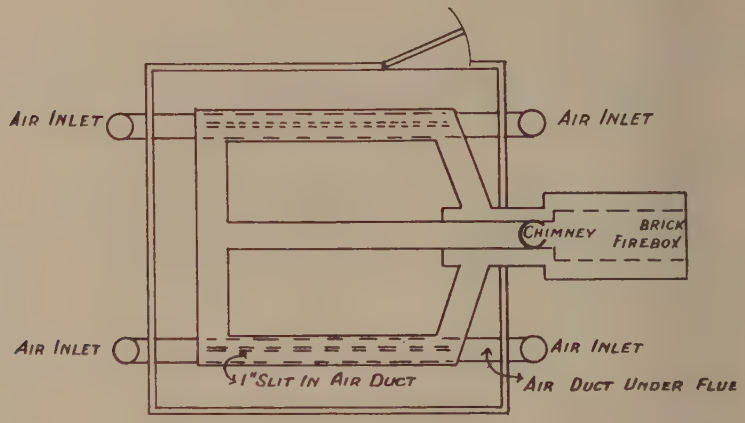
The following is a formula for *cement wash* which has proved quite satisfactory:—

1¼ gallons Water.
12 lbs. Cement.
2 lbs. Lime.
1 lb. Salt.
½ lb. Alum.

Sieve salt and lime together through a fine sieve. Add this to the water, then follow with cement, stirring while adding. Finally add the alum. Apply this mixture immediately with a fairly stiff brush, first wetting the bag wall. Two coats of the wash are required, and the first coat may be made slightly thinner than the above.

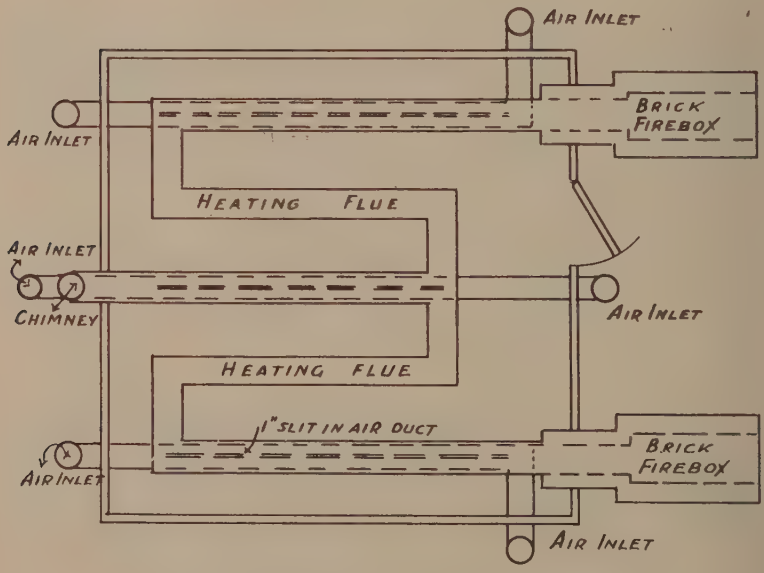
INSULATION OF THE WALLS.

Whatever material is used, it should be attached to both the inside and outside of the framing, and the heat-retaining qualities may be still further improved by filling the space between with some insulating material such as dry earth or sawdust. The experimental barn constructed by the writer was lined with asbestos-cement sheets on the inside and corrugated iron on the outside, and the space between was filled with sawdust. The roof was also lined with asbestos-cement



GROUND PLAN OF 12' x 12' BARN

Fig 4



GROUND PLAN OF 16' x 16' BARN

Fig 5

Figs. 4 and 5. Drawings showing ground plan of 12ft. x 12ft., and 16ft. x 16ft. tobacco-curing kilns, respectively. For description of kilns see text.

sheets. This arrangement gave complete satisfaction, there being no drop in temperature between the lowest and the highest tiers during curing, while the consumption of firewood was extremely small.

HEATING SYSTEM.

One brick furnace is capable of heating a 12 ft. barn, but in the case of the 16 ft. size, best results will be obtained by using two. The firebox should preferably be built a foot or two away from the barn, and should be sunk below floor level, so that a slightly sloping brick flue will connect it to the sheet iron flue pipes inside the barn just above floor level. These latter are usually about 11 inches in diameter and are made from 24 gge. gavanised iron. They may be arranged in a number of ways, the most usual for a small barn being as in figure 4. Here the incoming brick flue terminates in a T-piece, from which flues lead round either side of the barn, to meet again in the middle of the far end in another T-piece, from which a third line is taken back across the centre of the floor, and through the wall, just above the furnace, where it connects with the chimney.

CONSTRUCTION OF THE FIRE-BOX.

The brick firebox is usually 18 in. wide by 30 in. high by 5 ft. long, inside measurement. The walls should be 9 in. thick and support an arched roof. The mortar should consist of a mixture of clay and sand, as this will withstand heat far better than a cement or lime mortar. It is not advisable to incorporate iron arch supports as these expand when hot and may cause extensive cracking of the structure. To assist in controlling temperature a damper may be fitted at the base of the chimney, and it is advisable also to have a metal door at the mouth of the firebox. A piece of sheet iron held in place by a piece of timber or iron bar answers the purpose perfectly well.

VENTILATING SYSTEM.

A really efficient system of ventilation is essential, and it is in this respect that many of the older curing barns fail badly. The writer has examined many types, both here and in the Eastern States, varying from the simplest "rabbit hutch" type to the elaborate and expensive "forced draught" systems embodying power-driven fans which blow heated air through the barn. Fortunately, in the case of the small barns advocated for use here, an extremely efficient ventilating system can be constructed quite easily and at no great cost. It consists of two parts, an air inlet at ground level and an outlet at the apex of the roof. When the barn is in operation, with both top and bottom ventilators open, the warm air inside the barn, being less dense than the cooler air outside, rises and escapes through the roof vent. Its place is taken by air drawn through the bottom ventilators, which in turn becomes warmed and rises. The steady current of warm air thus passing up through the leaf hung in the barn carries away the moisture given off during the curing process.

The type of bottom ventilator in common use at present consists simply of a number of holes in the walls of the barn, which can be closed by hinged or sliding shutters. This type has some rather serious disadvantages. The incoming air is not well distributed throughout the barn, there being a tendency for it to rise along the walls, leaving the centre of the barn badly ventilated. In windy weather one side of the barn receives more ventilation than the other, and, most serious of all, if the shutters should have to be opened when rain is falling or on a cold, dewy morning, the cold, moisture-laden air which is introduced into the barn is unable to absorb the moisture being given off by the leaf, with the result that the condition

known as "sponging" occurs. To avoid these defects the incoming air should be led immediately under the heating flues by a series of ducts. The method adopted in the experimental barn at Jardee was to bend a number of 3 ft. wide sheets of 26 gge. iron into the form of a pipe, leaving an open slit one inch wide along the full length. These pipes were sunk in the floor of the barn so that the slit was immediately under a heating flue. Each end of the pipe led under the wall of the barn and communicated with the outside air by an elbow, at the mouth of which was a shutter by which the amount of ventilation could be regulated. A number of growers have copied this method, most of them using wooden ducts, and they report that the system works extremely well.

Fig. 6.—Experimental Tobacco-curing Kiln and four other kilns embodying most of the characteristic features of the writer's design, but being constructed with bag walls, on the property of Mr. G. F. Combs, Jardee.

(Photo. by Author.)

VENTILATION OF TOP OF KILN.

The top ventilation consists of an opening about one foot wide along the ridge of the roof. This opening should be continuous along the full length of the ridge. A solidly constructed wooden ridge cap, covered with galvanised iron, fits closely on top of the opening so that when closed it is as nearly airtight as possible. To open, this ridge piece is pushed up at each end by a perpendicular bar, sliding in an iron strap, and operated at its lower end by a lever working on a fulcrum. The amount of ventilation is regulated by an iron pin fitting into a series of holes, by which the lever is held in any desired position. This type of top ventilator is simple to construct and operate, offers the minimum of obstruction to the egress of the moisture-laden air from the barn, and its efficiency remains constant irrespective of the strength and direction of the wind.

SPACING OF TIER POLES.

The tier poles which support the sticks from which the leaf is hung are spaced at four-foot centres. They may be made of bush poles or, preferably, of 4 in. x 2 in. sawn timber. The perpendicular distance between each tier should be not less than 2 feet, and the bottom tier should be at least 7 ft. 6 in. from the floor. Thus a four-tier barn will require to be at least 14 ft. high to the eaves, and a five-tier one 16 ft. If it is desired to allow more space between the tiers to

accommodate very large leaf, the height of the barn will have to be made correspondingly greater. It is not advisable to have the tips of the bottom tier of leaf lower than 5 or 6 feet from the floor, otherwise they are liable to become scorched by the heat of the flues.

The door should not be less than 6 ft. 6 in. high by about 3 ft. wide. It should preferably be situated at the furnace end of the barn and should open outwards. It should be of solid construction and fit the doorway closely. It is a good idea to fit a small window about the level of the bottom tier so that a thermometer hung there can be read without the necessity of opening the door.

BRAN AND POLLARD.

ANALYSIS OF "F.A.Q." SAMPLES.

L. W. SAMUEL[1]
and
G. E. DEAN.[2]

The commercial milling of the 1936-37 season's f.a.q. wheat sample obtained from the Chamber of Commerce afforded an opportunity of analysing an "f.a.q." sample of bran and pollard.

The feeding stuffs analysis is shown in Table I., and the analysis of the ash in Table II.

Table I.

Analysis of bran and pollard from the 1936-37 *f.a.q. wheat sample.*

Analysis (on 13.5% moisture basis).	Bran.	Pollard.
Moisture, per cent.	14.35	14.50
Ash, per cent.	3.42	2.07
Crude fibre, per cent.	7.38	3.33
Nitrogen, per cent.	2.22	2.20
Protein (N x 6.25), per cent.	13.85	13.75
Ether extract, per cent.	2.97	3.81
Nitrogen free extractives, per cent.	58.88	63.54
Guthrie value	79.4	85.9

Table II.

Analysis of ash of bran and pollard from the 1936-37 *f.a.q. wheat sample.*

	Bran.		Pollard.	
	On material.*	On ash.	On material.*	On ash.
Acid insoluble, per cent.	0.04	1.17	0.02	0.97
Calcium, per cent.	0.09	2.51	0.05	2.41
Magnesium, per cent.	0.33	9.53	0.18	8.75
Potassium, per cent.	0.95	27.6	0.53	25.6
Phosphorus, per cent.	0.58	17.0	0.35	16.9

* Standard moisture basis of 13.5 per cent.

From Table I. the bran and pollard are equal as source of protein, but the pollard has a higher energy value than bran because of its lower fibre content and higher fat content. Pollard, however, provides less minerals than does bran.

From Table II. there is little difference in the composition of the ash from bran and pollard, but because of its higher ash content bran provides nearly twice as much calcium, magnesium and potassium as does pollard and more than one and a half times as much phosphorus.

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[1] Cereal Research Officer, Department of Agriculture.
[2] Chemist, Government Chemical Laboratory.

It may be noted here that the protein contents of the "f.a.q." bran and pollard are close to the figures recorded by Underwood and Snook (Journal Department of Agriculture, W.A., 12 No. 3, September, 1935, p. 326), but are considerably lower than the figures recorded by Sutton (*ibid.* 10 September, 1933, p. 381).

Sample.	Per cent. Moisture.	Per cent. Protein (N x 6.25) On 13.5% Moisture Basis.	Per cent. Protein (N x 6.25) On Dry Basis.
Bran:			
F.A.Q. 1936-37	14.35	13.85	16.0
Underwood & Snook* ..	11.0	13.2	15.3
Sutton	12.0	15.7	18.2
Pollard:			
F.A.Q. 1936-37	14.5	13.75	15.9
Underwood & Snook* ..	10.0	12.8	14.8
Sutton	12.0	16.7	19.3

* Average of five samples.

The figures calculated on the dry basis are given for comparison with the values recorded by Sutton (l.c.), but for calculation of rations the figures on a 13.5 per cent. moisture basis should be used.

In view of these figures it is recommended that, when purchasing bran and pollard as protein supplements, a protein content of approximately 13.3 per cent. for bran and 13.0 per cent. for pollard be used in the calculation of the ration.

AGRICULTURAL PROBLEMS.

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district of the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

The addresses and name of Advisers are as follows:—

Albany	A. C. Vaughan.
Bridgetown	A. Flintoff.
Bunbury	M. Cullity.
Denmark	V. L. Cardon.
Geraldton	G. L. Throssell (Government Buildings).
Gosnells	R. C. Owen.
Harvey	D. L. Breen (Fruit); C. Giles (Dairying).
Katanning	A. S. Wild
Kalamunda-Roleystone	W. H. Read, c/o. Department of Agriculture, Perth.
Manjimup	K. W. Simes.
Metropolitan, Gingin, Chittering ...	S. E. Bennett, c/o. Department of Agriculture, Perth.
Metropolitan to Spearwood ...	R. L. Cailes, c/o. Department of Agriculture, Perth.
Mundaring	V. Cahill.
Narrogin	H. R. Powell.
Northam	F. L. Shier.
Northcliffe	H. S. Rogers.
Vasse	J. M. Nelson.

MAIZE VARIETY TRIALS, 1936-37.

H. G. ELLIOTT,
Agricultural Adviser, Dairy Branch.

The Maize Variety Trials were conducted again this season. From the results obtained during the previous three seasons the indications were that "Fitzroy," "Mammoth White Ensilage" and "Silvermine" were slightly superior to the standard variety "Hickory King" for a green fodder crop, but "Hickory King" was still recommended as a standard variey.

The object of the trials was to determine which variety, if any, of the ones listed below would give higher yields of green material per acre than "Hickory King." The varieties used were:—

1. "Hickory King." Standard variety for green fodder in this State.
2. "Fitzroy."
3. "Silvermine."
4. "Small Leaming."
5. "Mammoth White Ensilage."
6. "Golden Superb."

The following varieties have been deleted during the last two seasons owing to unsuitability:—

1. "Early White Dawn."
2. "Funk's Early Yellow Dent."
3. "Early Morn."
4. "90-Day Flint."
5. "Wellingrove."

Fertilisers.—Superphosphate and Ammonia No. 3 in proportions of 2½ parts superphosphate and 1 part of sulphate of ammonia, at the rate of 3 cwts. per acre, were used. This was the same as for the previous seasons. The cost of the fertiliser was borne equally by Cuming Smith & Mt. Lyell Farmers' Fertilisers Ltd. and the Department of Agriculture.

Each variety was sown in triplicate in rows approximately 30 inches apart, 25 lbs. of seed per acre being sown in every case.

The trials were conducted by officers of the Dairy Branch in various districts as shown in Table 1.

TABLE 1.

GREEN MATERIAL PER ACRE.

Name.	District.	—	Hickory King.	Fitzroy	Silver-mine.	Small Leaming.	Mammoth White.	Golden Superb.
*J. Brett ...	Dardanup ...	Tons per acre ...	14·51	20·31	19·35	19·33	24·17	18·06
		Percentage yield	100	140	133	133	166	124
J. W. Pratt ...	Northcliffe ...	Tons per acre...	27·91	32·83	30·37	28·94	30·80	29·37
		Percentage yield	100	118	109	104	110	105
*J. Hardestry ...	Dardanup ...	Tons per acre...	25·96	15·91	26·52	15·63	22·08	20·33
		Percentage yield	100	61	102	60	85	80
W. Warham ...	Denmark ...	Tons per acre...	23·75	15·00	18·35	22·65	21·60	20·50
		Percentage yield	100	63	77	95	91	86
A. Millar ...	Forest Grove	Tons per acre...	4·73	5·20	3·08	4·13	5·51	3·80
		Percentage yield	100	110	65	88	116	80
R. Taylor ...	Vasse ...	Tons per acre...	4·83	5·42	5·78	5·08	5·19	4·95
		Percentage yield	100	112	119	104	108	102
Average ...	... ...	Tons per acre...	16·96	15·78	17·24	15·96	18·22	16·16
		Percentage yield	100	93	102	94	108	95

* NOTE.—Grown under Irrigation.

The average production of green material and percentage yields for all trials for the four seasons 1933-34 to 1936-37 are given in the following table:—

TABLE 2.

GREEN MATERIAL.

Variety.	1936-37.			1935-36.			1934-35.			1933-34.			Average, 1933-1937.		
	Average Yield per Acre.	Percentage Yield.	No. of Trials.	Average Yield per Acre.	Percentage Yield.	No. of Trials.	Average Yield per Acre.	Percentage Yield.	No. of Trials.	Average Yield per Acre.	Percentage Yield.	No. of Trials.	Average Yield per Acre.	Percentage Yield.	No. of Trials.
	tons.			tons.			tons.			tons.			tons.		
Hickory King	16·96	100	6	16·55	100	9	18·19	100	12	17·23	100	25	17·21	100	52
Fitzroy	15·78	93	6	17·94	108	8	21·80	120	6	19·87	115	13	19·01	110	33
Mammoth White Ensilage ...	18·22	108	6	18·15	110	6	...	...	...	...	...	...	18·19	106	12
Silvermine	17·34	102	6	17·01	103	9	19·83	109	6	17·32	100	12	17·82	104	33
Small Leaming	15·96	94	6	16·95	102	9	17·33	95	6	17·08	99	13	17·00	99	34
Funk's Early Yellow Dent. ...	...	...	...	...	...	...	15·30	84	6	17·74	91	12	16·93	98	18
Wellingrove	...	...	...	16·04	97	9	18·16	100	6	16·16	94	13	16·54	96	28
Golden Superb	16·16	95	6	15·87	96	8	...	...	...	...	...	...	16·00	93	14
90-Day (Flint)	...	...	...	...	...	...	16·33	90	6	14·45	84	11	15·11	88	17
Early White Dawn	...	...	...	...	...	...	14·56	80	6	13·40	78	11	13·81	80	17
Early Morn	...	...	...	...	...	...	13·79	76	6	13·50	78	12	13·60	79	18

AUSTRALIAN MEAT BOARD.

The Australian Meat Board is inaugurating this year an All-Australian Competition for classes of export porker and baconer carcases, and entries for the first two competitions close on October 15th next. In conjunction with the Federal Council of the Australian Society of Breeders of British Sheep the Board is also conducting an All-Australian Fat Lamb Competition during the 1937-38 export season, and entrants may compete in any one or more of the monthly competitions which will be held for lambs slaughtered during the months from September to February. No entry fees will be charged and Championship and other awards of considerable value are being made.

Full details can be obtained from the country Advisers of the Department of Agriculture and from the Secretary of the Royal Agricultural Society.

SALINE SOILS OF WESTERN AUSTRALIA AND THEIR UTILISATION.

By L. J. H. Teakle, Plant Nutrition Officer.

It is nearly nine years since the first papers on soil salinity, or soil alkali as it was then more generally called, were published by the writer (Teakle, 1928, 1929). A great deal of valuable information on the subject with respect to Western Australian conditions has now been accumulated and it is the purpose of this paper to place before the farmers and others interested the conclusions which may be adopted in the utilisation of land more or less affected by an excess of soluble salts. The subject will be treated as briefly and concisely as possible in this paper as a more comprehensive treatment of the data is in the course of preparation. Much of the information with respect to crops, is obtained from the literature particularly from America (Harris (1920) and Kearney and Scofield (1936)) but the results of experiments conducted in this State will be used to the full as a basis for practical recommendations.

THE PROBLEM OF SALINE SOILS IN WESTERN AUSTRALIA.

Farmers have long been interested in the accumulation of salt in the soils of the agricultural areas of Western Australia and many opinions have been published through various agencies. Some appear to think that salt encroachment jeopardises the future of much of Western Australia's fertile agricultural land: others, with little more reason, refuse to recognise the existence of soil salinity as a problem at all. Both points of view, particularly the first one, are damaging to the reputation of the State and it is, therefore, proper that the situation should be evaluated as accurately as possible in the light of existing knowledge.

In the first place, it must be admitted that soil salinity is one of the problems on many farms in Western Australia. On the vast majority of farms, it is a very minor problem and a few acres of saline soils in a thousand will not affect the prosperity of the farmer or of the State. Some farms, less fortunately situated, are more or less seriously affected and, in some cases, have to be developed largely for grazing purposes. It is probable, however, that there is no farm in Western Australia on which soil salinity is so severe as to render it useless for any type of

agricultural development. It is the duty of the farmer to develop every portion of his farm for the purpose for which it is most suitable and this applies to areas affected by the salinity factor as well as other factors.

In Western Australia, there is a very general relationship between soil salinity and soil type. Certain soil types, especially in certain districts, are most liable to damage from accumulation of salt and other types are practically never affected or are naturally reclaimed by leaching following clearing.

There is also a relationship between district and the intensity of the concentration of salts in the soils. Districts in the mallee zone in the central southern portion of the State, where the rainfall is from 11 to 15 inches per annum, appear to be most seriously affected, a fact probably correlated with the salinity of the rainfall and restricted leaching (Teakle, 1937). Fortunately, little of these areas has been brought under cultivation and the most important agricultural districts are generally much more favourably placed with respect to the incidence of soil salinity.

The knowledge of the relationship between soil type and soil salinity enables one to make a prediction of the behaviour after clearing if the soil type and concentration of soluble salts is known. In general, under the low rainfall conditions of most of the wheat belt, say from 11 inches to 14 inches per annum, smuffy morrel soils and certain heavy clayey soil types will be most liable to salinity. In addition, soils of the depressions, which in the virgin state carry "sand" salmon gum (*Eucalyptus leptophylla*) yorrel (*E. gracilis*), swamp gimlet (*E. spathulata*), swamp tea tree (*Melaleuca thuyoides,*) boree (*Melaleuca pauperiflora and M. quadrifaria*) and related plants frequently are affected by a rise of salt some 10 or 20 years after the surrounding country has been cleared.

In the wetter districts, salt accumulation is liable to take place where seepage patches occur on slopes, and in valleys in which a salt water table forms at shallow depths due to seepage of water from surrounding country. It rarely happens that any considerable area becomes affected with salt under these conditions and improvement of the condition, due to the washing out of the salt with the increased drainage is usually observed within 10 to 20 years of the first appearance of the salt.

As would be expected, it is in the drier areas that the problem, where it occurs, offers greatest difficulties. Even in these areas, leaching takes place rapidly after clearing where the soil has a sandy surface. This sandy surface is of great importance as it promotes water absorption and percolation and the removal of the salt. Leaching is considerably restricted, however, in heavy clayey soils and apparently in smuffy morrel types and, under these conditions, reclamation after clearing will be extremely slow if salts have accumulated in the subsoil under virgin conditions. Furthermore, smuffy morrel types and crabhole types are liable to surface accumulations of salt after clearing if the subsoil has developed salinity when virgin. Consequently it is the heavy forest soils and the smuffy morrel soils which are liable to cause trouble from salinity in some districts and, under these circumstances, need most careful consideration in development.

In considering the extent of the saline soils in Western Australia, it is well to remember that all countries of the world where low rainfall conditions exist are faced with similar conditions. Accumulation of soluble salts is a natural consequence of low rainfall conditions under which leaching is restricted or practically non-existent. It is reported that one-tenth of the irrigated land in the western part of the U.S.A., or approximately 1,500,000 acres, contains an injurious quantity of salts. (Kearney and Scofield, 1936). Thorp (1936) describes the saline soils of China, and there is quite an extensive literature dealing with occurrences in

Russia, Hungary, Asia Minor, India, Egypt, South America and other countries. In Australia, saline soils are known to occur in all States, and have been studied particularly in the irrigation areas of the Murray and Murrumbidgee Rivers and in Western Australia. Prescott (1931) briefly reviews the position and shows that in the Murrumbidgee area the normal soils are not usually saline. Recent observations, however, have shown that salt is appearing in portions affected by seepage, particularly from the rice fields. Saline soils do occur in other parts of the "mallee" areas of Victoria, New South Wales and South Australia under virgin conditions, but serious surface accumulation develops principally as a result of the rise of the water table following excessive irrigation. Most serious damage is reported from the Tresco Irrigation District, Victoria, by Read (1931) and by Taylor *et al* (1933), who estimate that over 50 per cent. of the irrigated planted area of 2,500 acres has been withdrawn from cultivation on account of salt troubles. Irrigated land at Kerang, Victoria, has also been seriously damaged under similar conditions. It is probable that at least some evidence of soil salinity is to be found in every irrigation area of Australia.

In Western Australia soil salinity in the irrigation areas should be of very uncommon occurrence and the few instances reported have been due to poor drainage, which is easily rectified in most cases. The heavy winter rains can be used to remove soluble salts, accumulated during the summer as a result of injudicious irrigation, if proper drainage is provided. The occurrence of soil salinity in the agricultural areas has been mentioned above. It was reported in an earlier publication (Teakle, 1929), that inquiries instituted by the Royal Society of W.A. indicated that probably about 3 per cent. of the farming lands of the State may be affected by salt encroachment.

TABLE 1.

Estimated Area of Land Affected by Salinity following the Clearing of Timber on Selected Farms in the Wheat Belt of Western Australia.

Locality.	Total Area.	Estimated Area Affected by Salinity.	Per cent.
	acres.	acres.	
Wagin (6 farms)	9,252	291	3·1
Other G.S.R. Centres (12 farms)	25,692	289	1·1
Other Centres (11 farms)	25,753	1,320	5·1
Total for State (29 farms)	60,697	1,900	3·1

(The writer is indebted to Mr. W. E. Wood who kindly supplied the figures from which these calculations were made.)

It is probable that similar inquiries at the present time would show a somewhat larger percentage, but, except in certain districts, it would be of the same order of magnitude.

Instances of three badly affected farms in the Bruce Rock area under a 14 inch rainfall will show the conditions in extreme cases in the wheat belt. These farms were situated in the lowest parts of valleys, probably once old lake beds, and the development of the surrounding country caused the salt water table to rise with consequent salt encroachment in the lowest areas.

The accumulation of salt under higher rainfall conditions was investigated in the York district (17.77 inch average rainfall) and showed encroachment on the valley soils, but none of the higher land was endangered.

The situations on these four farms are summarised in Table 2.

TABLE 2.

Salt Encroachment on Examples of Badly Affected Farms in the Wheat Belt of Western Australia.

District.	Average Annual Rainfall.	Area of Normal Soils.				Scrub Plain and Third Class Soils.	Low-lying Lakey Soil Types Affected by Salt Encroachment.	Rocks, Lakes, etc.	Total Area of Farm.
		No Salinity.	Moderate Salinity.	High Salinity.	Total.				
	inches.	acres.	acres.	acres.	acres.	acres.	acres.	acres.	acres.
Bruce Rock	14·15	208	135	153	496	....	471	10	977
Bruce Rock....	14·15	464	58	17	539	45	412	4	1,000
Bruce Rock	14·15	610	10	38	658	24	294	4	980
York	17·77 (60 years)	570	21	107	698	....	....	....	698

It will be seen that the amount of arable land damaged by salinity in these extreme cases amounts to less than 30 per cent. of the area of normal soils on the holding most seriously affected. The most extensive loss is in the low-lying lakey soil types which must be regarded with suspicion from the start. Development of such lands should be undertaken with a knowledge of the prospect of salt encroachment within a number of years and plans made accordingly.

The prospect in the agricultural areas of Western Australia can best be gauged from a consideration by districts rather than of the situation on individual farms. Investigations over the agricultural areas of the State have been made and show that soil salinity assumes greatest proportions in the south central portion of the mallee zone of the State. In the agricultural areas the western and northern limits of this portion of the State will be somewhat east of Newdegate, in the vicinity of Glenelg Hills and somewhat south of Southern Cross. It includes the Lakes District, the original 3,500 Farms Scheme and the Salmon Gums area.

The main agricultural development in the State lies to the westward and northward of this area and appears to be much more favourably situated with respect to the incidence of soil salinity. Within this area detailed investigations have been carried out in the Lake Brown and related districts of the north-eastern wheat belt and in the Cleary area and whence complaints of damage from salt encroachment have been forthcoming for a number of years. The results of these investigations are summarised in Table 3, for comparison with the situation further eastward in the 3,500 Farms Scheme area, the Lakes District and the Salmon Gums District.

TABLE 3.

Incidence of Soil Salinity in certain Districts in Western Australia.

District.	Average Annual Rainfall.	Area of Normal Agricultural Soils.				Scrub-plain Soils.	Low-lying Lakey Soil Types.	Rocks, Lakes, etc.	Total Area Examined.
		No Salinity.	Moderate Salinity.	High Salinity.	Total.				
	inches.	acres.	acres.	acres.	acres.	acres.	acres.	acres.	acres.
Lake Brown....	11–13	209,826	41,485	41,877	293,188	57,704	28,704	6,136	385,732
Cleary	11·26	6,255	2,322	845	9,422	6,930	1,044	1,764	19,160
Lakes District	12-15	89,562	6,625	68,606	183,116	36,521	18,323	9,030	228,667
Salmon Gums	12-16	284,873	63,446	195,932	544,251	11,666	6,557	19,544	582,018
		No. of Sites.	No. of Sites.	No. of Sites.	Total.				
3,500 Farms Scheme	....	277	173	159	609				

Of the areas of normal agricultural soils, smuffy morrel types account for 38,625 acres at Lake Brown, 748 acres at Cleary and 59,700 acres in the Lakes District.

With respect to salinity, the morrel types in these districts were badly affected as about 15,000 acres at Lake Brown, 153 acres at Cleary and 40,300 acres of these types were found to be saline.

In the Salmon Gums District, the heavy textured soils and the so-called "kopi" soils exhibited the highest degrees of salinity.

It is evident that soil salinity is not a major problem of the north eastern wheat belt though the value of some farms has been seriously depreciated as a result of the occurrence of salt. Furthermore, the figures for the Lake Brown area rather over-emphasise the magnitude of the area of saline soils, as the scope of the investigation was based primarily on complaints regarding the occurrence of salt and districts from which no complaints were received were not surveyed. It is probable that the figures for Cleary are more representative of the situation in the main wheat belt. These show that 845 acres of otherwise normal agricultural soils out of a total area surveyed of 19,160 acres, or 4.4 per cent., are affected by salinity. If the area of normal agricultural soils is taken as a basis, the area affected would amount to 9 per cent. of this portion. Even in the more seriously affected areas of the Lakes District and the Salmon Gums District there is still a considerable area of "safe" agricultural land as far as freedom from salt is concerned, but greater care is needed in selecting land for wheat farming under these conditions.

It appears that, of the important soil types, the smuffy morrel types, particularly under low rainfall conditions, are most liable to salinity. This, combined with a natural disability of these types for wheat cultivation under low rainfall conditions, renders the problem largely one of the utilisation of morrel lands. In the Salmon Gums district there is the added problem of the utilisation of saline heavy textured soils.

It is fortunate that the soil surveys have provided detailed information concerning the nature and distribution of soil types in the wheat belt and point the way to the development of holdings for the type of agriculture for which they are most suited. Wheat cultivation on the satisfactory soil types now follows safe and well-established procedures, but the utilisation of the saline lands presents considerable difficulties. They are most easily developed in association with wheat lands and afford opportunities for pasture establishment as has been shown by experiments conducted in various parts of the wheat belt. It is purposed to discuss methods of utilisation of saline lands, with particular reference to Western Australian conditions, in the next section.

THE UTILISATION OF SALINE SOILS.

The recognision of the occurrence of saline soils has been followed by investigations designed to point the way to methods of utilisation of these areas. In the first place, it must be remembered that wheat for grain, the staple crop of the areas in question, is sensitive to relatively low concentrations of salt and in most instances it is necessary to consider pasture and forage crops in its stead. Pasture and forage crops are recognised as more tolerant than grain or fruit crops and it is in this direction that utilisation of saline soils must be attempted. Irrigation is out of the question so the natural forces have to be relied upon to reclaim the affected land.

The principles involved in the utilisation of saline soils may be summarised as follows:—

1. A knowledge of the amount and composition of the soluble salts and seasonal fluctuations.
2. Selection of tolerant plants.
3. Good cultivation to retard surface accumulations.
4. Planting or seeding when the surface concentration in the soil is at a minimum, *e.g.*, after a good fall of rain.
5. Maintenance of a surface cover as far as possible to protect the soil from surface evaporation.
6. Control of water table or seepage zones by drainage, etc.
7. Use of the crop for forage or pasture purposes as the quality of grains, fruits and vegetables is damaged by salinity.

The three most common constituents of the salts in soils are sodium chloride (common salt), sodium sulphate (Glauber's salts) and sodium carbonate. Of these, sodium carbonate is by far the most serious. It is the dreaded "black alkali" of California and is indicative of unfavourable soil conditions both physical and chemical. Sodium chloride is much less injurious than sodium carbonate but is probably almost twice as damaging to most plants as is sodium sulphate which is the least injurious of the common soil salts. In Western Australia sodium chloride generally constitutes about 70 per cent. of the total water soluble salts in saline soils and sodium carbonate and sodium sulphate are of minor importance. As sodium sulphate is one of the commonest salts in American saline soils, cognisance of the difference in effect on plant growth must be taken in interpreting American standards of salt tolerance for local conditions.

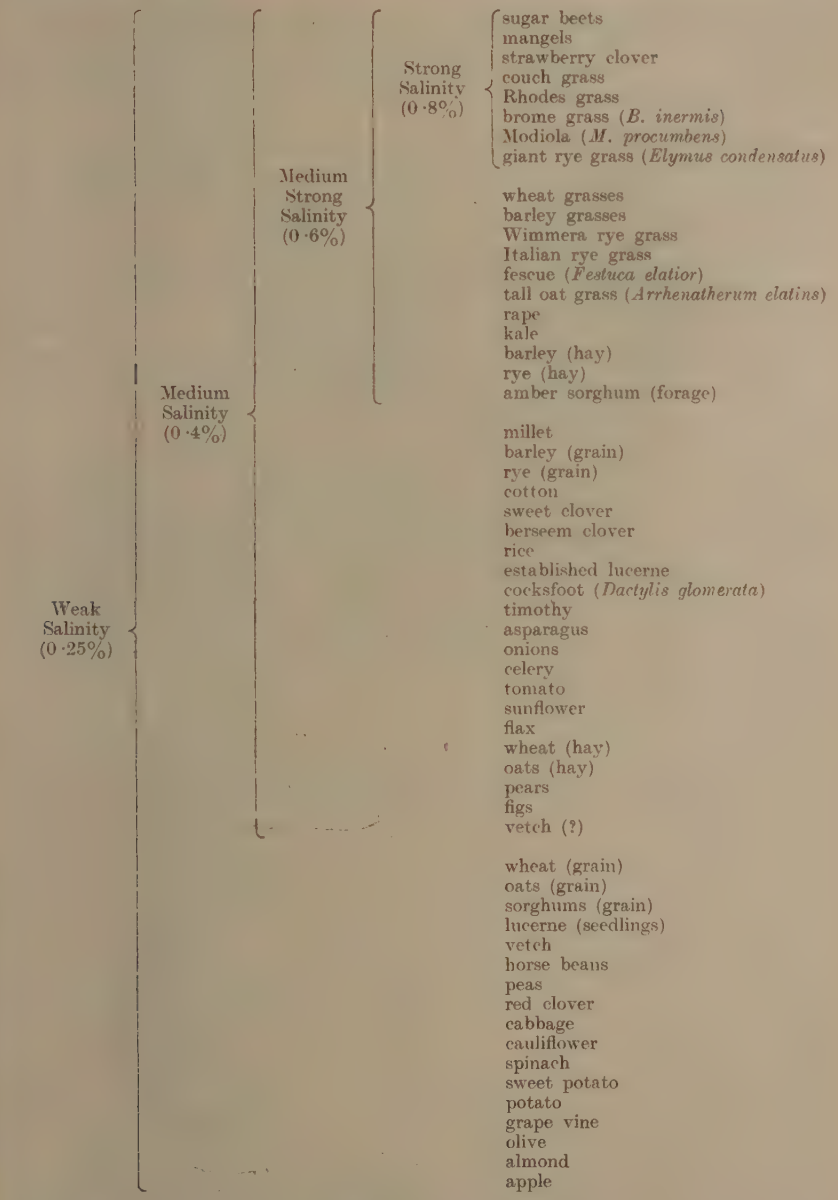
A very important point is the distribution of the salt in the soil. Surface concentration is most undesirable particularly in the early stages. Thus, in Canada, it was observed that wheat growth was good where the surface 6 inches contained no salt although the 6 to 18-inch layer contained 0.18 per cent. water soluble salts and the deeper layers 0.80 per cent. Poor growth occurred where the surface 6 inches contained 0.12 per cent. water soluble salts and the subsoil 0.70 per cent. Generally wheat growth is unaffected by 0.11 per cent. water soluble salts and half yield may be expected at a concentration of 0.25 per cent.

Where plants such as lucerne are well established a surface encrustation of salt will not be deleterious if the subsoil is weakly saline. Damage frequently occurs, however, if the surface crust is dissolved and washed down into the root zone.

It is important to review the salt tolerance of various plants of agricultural value in order that a selection may be made for developmental purposes. Much valuable information is given by Harris (1920) and Kearney and Scofield (1936) and may be summarised as follows:

Few plants of economic importance will thrive where the salinity is in excess of 1 per cent. when the dominant constituent is sodium chloride. Salt bushes (*Atriplex* spp., *Bassia* spp. and *Kochia* spp.), sugar-beet and other members of the Goosefoot family (*Chenopodiaceae*), date palms, pomegranate and certain salt grasses (*Distichlis stricta, Puccinellia nuttalliana, Sporobolus airoides*) are most likely to succeed if establishment can be effected before the concentration becomes excessive.

Where the concentration is below 1 per cent., there is a better choice of plants. The following table gives an interesting survey of the plants likely to succeed in the presence of different degrees of salinity.



Sensitive plants which will not tolerate more than about 0.1 per cent. total water soluble salts include oranges, lemon, mulberry, plum, peach, apricot, cherry, walnut, maize, bluegrass, radish, carrot, parsnips, artichoke, etc.

Ornamental and shade trees which will tolerate moderate to strong salinity are "cape liliac" (*Melia azedarach*), planetree (*Platanus orientalis*), oleander, palms, flood gum (*Eucalyptus radis*), old man salt-bush (*Atriplex nummularium*), tamarisk (*Tamarix gallica*), pomegranate, etc.

It is commonly observed that well cultivated land shows less evidence of surface accumulation of salt than adjacent uncultivated land. Thus, there is a better

opportunity for establishment of plants on soils with a good tilth, particularly if planting is preceded by leaching out of salt from the surface layers by irrigation or generous rains. A good stand of plants retards surface evaporation and surface accumulation of salts, and also contributes to a most desirable increase in the humus content of the soil.

Seedlings are generally most sensitive to salinity and establishment is always a difficulty. Once well established, growth is likely to be satisfactory as long as the soil moisture is maintained, but the quality of the plants is often deleteriously affected when grown on saline soils. Wheat quality is affected and the grain often shrivelled, sugar beets do not grow to full size and the purity of the juice is impaired, cotton is reduced in quality, delicate fruit flavours fail to develop, and the burning quality of tobacco is ruined. The salt content of certain forage plants such as salt bush may be too high to be used in large quantities for stock feeding.

In order to determine most suitable crops for saline soils in Western Australia, a number of experiments have been conducted on the Salmon Gums Research Station and on private farms at Corrigin. In all cases yield of forage has been sought on account of the risk involved with grain crops.

1.—*Crops for "Kopi"* Soils and Saline Clay Soils.*

Over a number of years plots of wheat, oats, barley, rye and Wimmera rye grass have been grown as forage crops on these soil types on the Salmon Gums Research Station. Yields of forage have been determined by cutting quadrats at the time of "flowering" and grain yields have been obtained subsequently in some instances by harvesting the plots with a harvester. The results for 1931, 1932, and 1933 have been published by Thomas and Seinor in this Journal for 1932, 1933, and 1934 respectively. A summary of the information to date is given in Table 4.

The yields point to the value of barley, rye and Wimmera grass for both kopi and saline clay soils.

TABLE 4.

Yield of Green Material Harvested at "flowering," and of Grain from various Crops grown on "Kopi" Soils (Beete calcareous sandy loam) and Saline Clay Soils (Kumarl clay loam) on the Salmon Gums Research Station.

Year.	Annual Rainfall.	Wheat.			Barley Cape.	Oats (Mulga).	Rye.	Wimmera Rye Grass.
		Gluyas Early.	Bencubbin.	Noongaar.				
A.—"KOPI" SOILS (BEETE CALCAREOUS SANDY LOAM).								
Yield of Green Material.								
	inches.	tons per acre.	tons per acre.	tons per acre.	tons per acre.	tons per acre.	tons per acre.	tons per acre.
1931	16·69	....	....	2·66	4·80	5·18	4·46	6·34
1932	13·07	....	....	1·67	3·43	2·74	4·07	5·83
1933	12·13	....	....	0·76	....	1·76	3·24	1·51
1935	11·00	·65	....	....	....	·97	1·02	·75
1936	11·16	·76	....	....	....	·66	1·26	·78
Yield of Grain.								
		bus. lbs.				bus. lbs.	bus. lbs.	bus. lbs.
1935	11·00	5 44	....	....	....	3 13	3 51	..
1936	11·16	6 19	....	....	....	3 13	3 20	..
B.—SALINE CLAY SOILS (KUMARL CLAY LOAM).								
Yield of Green Material.								
					Atlas.			
		tons per acre.	tons per acre.	tons per acre.	tons per acre.	tons per acre.	tons per acre.	tons per acre.
1935	11·00	·96	·73	·56	....	·62	1·09	·89
1936	11·16	1·42	1·28	....	1·62	·90	1·73	·81
Yield of Grain.								
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.
1935	11·00	5 15	5 21	3 15	....	1 25	5 21	..
1936	11·16	11 30	8 24	....	10 48	3 20	8 26	..

* "Kopi" soils are grey calcareous sandy loams related to the snuffy morrel types and have been named th Beete calcareous sandy loam.

The effect of stable manure proved very beneficial on "Kopi" soils and gave an average increase in yield of 72 per cent. in the experiment carried out. (See Table 5.)

TABLE 5.

Effect of Dressings of Stable Manure at the rate of 15 tons per acre on the Yield of Wheat on "Kopi" Soils on the Salmon Gums Research Station. A basal dressing of 1 cwt. of Superphosphate per acre was used in each Treatment.

Year.	Annual Rainfall.	Variety.	No stable manure.		15 tons stable manure per acre.	
	inches.		bus.	lbs.	bus.	lbs.
1932	13·07	Gluyas Early	13	47	19	17
1933	12·13	do.	7	1	9	36
1934	15·50	do.	5	36	12	16
1935	11·00	do.	4	32	9	12
1936	11·16	do.	4	19	10	21
		Average	7	8	12	8

2.—*Species trial on the saline clay soils (Kumarl clay loam).*

In order to determine the suitability of a wide range of pasture species for the saline clay soils, a comprehensive experiment was arranged and is in progress on the Kumarl clay loam on the Salmon Gums Research Station. Small plots, 10 links by 15 links, in area, on fallowed land are sown to the various species and growth noted.

The following 27 species either failed to germinate or made little or no subsequent growth in the 1935 and 1936 seasons: Annual veldt grass (*Erharta longiflora*), *Digitaria Pentzei*, wheat grass (*Agropyron cristatum*), brome grass (*B. inermis*), subterranean clover (*Trifolium subterraneum*) cluster clover (*T. glomeratum*), medic (*Medicago sp.*), burr trefoil (*M. denticulata*), hairy burr trefoil (*M. minima*), lucerne (*M. sativa*), blue lupin (*Lupinus varius*), narrow leaved blue lupin (*L. angustifolius*), *Danthonia sp.*, perennial veldt grass (*Erharta calycina*), *Phalaris tuberosa, Pentzia virgata*, native blue bush (*Kochia sp.*), Mulla mulla (*Trichinium alopeceuroideum*, and *T. exaltatum*), native vetch (*Swainsona spp.*), *Psoralea bituminosa* and *Lespedeza striata, Lotus corniculatus*, Araby grass (*Schismus barbatus*), Evening primrose (*Oenothera sp.*), small seeded horse bean (*Vicia faba var. equina*). Some growth was made by Mexican Spinach (*Chenopodium album*) which attained a height of 12 inches, *Atriplex canescens* and Italian rye grass (*Lolium perenne var, multiflorum*) but in all cases Wimmera rye grass (*Lolium rigidium var. subulatium*) as a weed seriously interfered with the establishment of these less vigorous plants.

Very promising results were obtained with 5 species. Wimmera rye grass proved outstanding and was difficult to control on the other plots. Esperance rye grass (*Lepturus incurvatus*) gave quite good growth but was less vigorous than Wimmera rye grass under the conditions of the experiment. Of the salt-bushes tried, trailing salt bush (*Atriplex semibaccatum*) and American burr (*Bassia hyssopifolia*)| gave considerable promise and are worthy of a trial for forage purposes. Trailing salt bush is a hardy perennial fairly palatable to stock and American burr is a spring and summer growing bushy annual which spreads readily by seeds. It appears to be readily eaten by stock. Another salt-bush, Queensland salt bush (*Atriplex Muelleri*), made fair growth but was inferior to the above types.

Experiments with the most promising of these species are continuing with a view to extending their usefulness to the field.

3.—*Experiments on lowlying sandy surfaced soils at Corrigin.* Conducted by Mr. R. P. Roberts.*

In many parts of the wheat belt considerable areas of lowlying country associated with the salt lake systems are fairly moist during the summer months and are liable to salt encroachment The soil consists generally of 3 or 4 inches of light grey brown sand overlying a light grey sandy clay which is usually calcareous from about 20 inches deep.

In 1933 an experiment was arranged on Mr. G. W. Smith's farm in the Corrigin district and a number of summer growing crops sown on fallow on 5th October, 1933. The soils were very slightly saline, the concentration in the surface foot being 0.03 to 0.05 per cent. sodium chloride, and in the second foot 0.07 to 0.13 per cent. sodium chloride.

The crops tried were Sudan grass, Japanese millet, sorghum (saccaline), sunflower, lucerne, cow peas, maize, elephant grass and kikuyu grass. Germination was poor and the dry summer conditions interfered with growth, but Sudan grass, elephant grass, lucerne and kikuyu grass gave promise of being of value.

Later experiments were conducted on Mr. Colin Grasby's farm in the same district. In the first year maize, millet, Sudan grass, lucerne and *Digitaria sp.* gave poor results, but kikuyu grass and sorghum were distinctly promising. American burr showed poor germination, but some plants made good growth.

In 1935 the work was continued with winter crops of which rye, Wimmera rye grass and Atlas barley proved most satisfactory. Conditions were unfavourable for *Phalaris tuberosa,* burr trefoil and wheat.

RECOMMENDATIONS AND CONCLUSIONS.

On the basis of the information reviewed in this paper, the following recommendations are made for the utilisation of soils more or less affected by salinity. As further information is gathered in the course of experiments, it is expected that these recommendations will be extended and improved. Of course it is not to be expected that plants will readily establish on salt encrusted and bare patches, but if a cover can be effected on the intervening soil, which is generally low in salt content, there is a possibility that the bare patches will be reclaimed by gradual encroachment of the plants on the marginal areas.

For convenience, the situation is discussed first, from the viewpoint of the drier areas of the wheat belt, second, the wetter areas of the wheat belt, and third, of the high rainfall areas of the State.

1. The Drier Areas of the Wheat Belt.—There is no doubt that Wimmera rye grass offers the opportunity for the utilisation of heavy soil types and morrel soils. It should be sown at the rate of about 4 pounds per acre on cultivated land, or with a cereal crop, and should be annually top-dressed with superphosphate. As Wimmera rye grass is a spring grower, for early winter feed, barley and rye can be recommended and should be sown in the same way as wheat. Trailing salt-bush (*Atriplex semibaccatum*) and American burr (*Bassia hyssopifolia*) are promising to be valuable adjuncts in the utilisation of morrel and saline soils.

Stable manure is of considerable value for these soils and has increased the yield of wheat on "kopi" soils at Salmon Gums by 72 per cent.

2. The Wetter Areas of the Wheat Belt.—The same plants can be recommended for the wetter areas of the wheat belt, but, in addition, kikuyu grass, lucerne, elephant grass, sorghum, Sudan grass, rape and beet will prove of value

*Average annual rainfall, 15·90 inches (27 years).

where a certain amount of summer moisture is available. Seepage areas, which are liable to become salty, can probably be turned into assets by establishing kikuyu grass, elephant grass, bamboo (giant reed), etc., to absorb the excess moisture.

3. In the wetter areas of the State and where the soil moisture can be maintained during the summer months, strawberry clover will be the most satisfactory legume for saline soils, and common pasture grasses such as perennial rye grass, fescue, etc., will be found to be tolerant of moderate concentrations.

In conclusion, other points of interest deserve attention.

(a) It seems unlikely that more than about 5 per cent. of the lands of the main wheat belt of Western Australia are liable to damage from soil salinity. Damage is largely confined to certain soil types and to low-lying areas of "lakey" soils.

Soil salinity is more general in certain areas of the south central portions of the mallee zone of the State, including the Lakes District, the 3,500 Farms Scheme and the Salmon Gums district. Agricultural development in these areas is proceeding with adequate caution.

(b) In the wetter areas of the wheat belt, the salt encroachment comes to a maximum within a few years after the clearing of the country. Thereafter, improvement due to the washing out of the salts and removal in the drainage water gradually occurs.

(c) Inadequate rainfall in certain seasons and failure to follow the soundest methods of wheat cultivation are responsible for complaints regarding soil salinity in many instances in the lower rainfall areas.

(d) For ornamental and shade purposes there are a number of plants which are tolerant of soil salinity if moisture is available. The date palm deserves recognition for this purpose, and Tamarisk, flood gum, Cape lilac, old man salt bush, and various native trees and shrubs should prove useful in many instances.

(e) Certain drainage works will be of value in the reclamation of saline land in the high rainfall areas, but are unlikely to be of much practical importance in the drier districts except under special circumstances.

(f) It should be noted that, while Wimmera rye grass is a valuable pasture plant, it is likely to become a serious weed in the wheat crop unless it is properly controlled by appropriate grazing and cultural treatment.

ACKNOWLEDGMENT.

Acknowledgment is made of the work of officers of the Wheat Branch in the conducting of the experiments described in this paper.

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EXPORT BACON CLASS—ROYAL AGRICULTURAL SHOW, 1936

G. K. BARON-HAY, Superintendent of Dairying.

Since the inauguration of the Export Bacon and Pork Classes in the Royal Show Schedule in 1934, through the generosity of the Perpetual Trustee Executor Company, considerable valuable information has been obtained regarding the type of pig required for the export trade, and how to produce that pig. This trophy, however, lapsed in 1935.

During last year a Class for "Three Bacon Pigs suitable for Export" was included in the Schedule through the generosity of Meggitts Pty., Ltd., and Messrs. Brown and Dureau, Ltd.

The judging of this Class was carried out under most searching conditions involving:—

1. The weighing of pigs on the Show Grounds to ascertain if they conformed to the required live weights, namely 170 to 210 lbs.
2. The judging of the pigs on the hoof by inspection.
3. The slaughter of all exhibits and the judging of carcases, one being cut and judged by measurement.

The awards were made by the judges, Messrs. H. Watson, J. P. Massey, and the writer, on the combined results of the above inspections.

Fourthly, in order to obtain information regarding the value for the British bacon market, all pigs were consigned to Mr. S. B. Fletcher, London, who arranged for the carcases to be judged by inspection, this work being carried out by Mr. Yuill of Kersans Ltd., Mr. A. Fletcher of Fletcher and Sons, Mr. McDonald and Mr. Lockhart of Denny and Sons, and Mr. Robert Scott of Glasgow. The best three carcases and the worst three were selected, the final decison being unanimous.

Finally, the carcases were submitted to Messrs. Denny and Sons of Glasgow for curing, the resultant bacon sides being graded by that firm.

All these results are now available, and, taken with the experience during the two previous years, yield valuable information.

The entries received for this Export Class and for the Pork and Bacon Classes for the Local Trade were the largest ever received at the Royal Show, and indicate the interest being taken by farmers in commercial pig-raising as distinct from stud-breeding.

The points awarded to each exhibit locally is shown in the following Table 1:—

TABLE 1.

EXPORT BACON CLASS.

Royal Show, 1936.

Entry No.	Points by Measurement of Carcase.					Points on Live Judging.	Total Live and Carcase Judging.
	Length.	Backfat.	"Eye" of Loin.	Hams, Skin, etc.	Total.		
Max. ...	30	20	30	20	100	100	200
174 ...	28	18	30	18	94	95	189
179 ...	28	18	26	18	90	95	185
176 ...	28	14	30	18	90	93	183
177 ...	28	16	28	18	90	90	180
172 ...	26	16	26	16	84	95	179
180 ...	28	10	26	19	83	93	176
170 ...	26	16	20	18	80	91	171
169 ...	28	12	22	18	80	88	168
171 ...	overweight						
173 ...	overweight						
175 ...	overweight						
178 ...	underweight						

A comparison of these points will indicate how necessary it is to judge Trade Classes both on the hoof and "on the hooks." This is well illustrated by Exhibits 172 and 180, which scored well on the hoof but did not come up to expectations after slaughter.

A comparison of the local judging with final awards overseas is given below in Table 2.

TABLE 2.

RESULT OF JUDGING EXPORT BACON CLASS.

Royal Show, 1936.

Entry No.	Total Points, Western Australia, by Inspection and Measurement.	Points, Overseas, by Inspection of Carcases only.	Grading of Three Wiltshire Sides.	Breed.	Remarks.
174	189	...	1. 1. 1.	L.W.	
179	185	First	1. 1. 1.	T x B	
176	183	...	2. 1. 1.	CAN. B.	
177	180	Second	1. 1.	CAN. B x B	Head condemned locally for T.B.
172	179	...	1. 1. 1.	T x B	Head condemned for T.B.
180	176	Rather fat	1. 2.	B x T	
170	171	...	1. 1. 2.	T	
169	168	One of worst	1. 1. 2.	B x T	
171	Overweight	do.	2. 2. 2.	L.W.	Not judged locally.
173	do.	do.	2. 2. 2.	?	do. do.
175	do.	Third	1. 1. 1.	L.W.	do. do.
178	Underweight	...	1. 1. 1.	L.W.	do. do.

The following report from the overseas Judges on the quality of the carcases will be of interest:—

"The best *show* pig was really No. 180, but from a curing point of view was carrying too much fat. They were really all good pigs, and it was difficult to discriminate. The selection was eventually narrowed down to the three best and three worst pigs, and the final decision was unanimous."

A gratifying feature of the judging is that the local selections agreed with those representing the first grade cured bacon sides.

In the first five places, of the 14 pigs cured, only one side cured "second grade," while the exhibits placed first and second locally all produced first grade cured sides.

It also will be noted that, where local weights considerably exceeded those recommended in the Show Schedule, namely 170 to 210 lbs. live weight, in two out of three such exhibits the sides were all graded second grade.

A feature of the competition was the uniform methods adopted for feeding, and a similarity in the proportions of the foods used.

Almost all competitors used crushed wheat as the basal grain, with an addition of meatmeal where skimmed milk was not available. When practicable, other grain such as barley or peas was used to replace a portion of the wheat.

In those instances where quantities of each food were given, the nutritive ratio was found to approximate 1 :4 for younger pigs, to 1 :4.75-5 for pigs of five to six months old, a typical ration being that of Mr. W. G. Burges, "Tipperary," for pigs over four months of age:—

Good Chaff	10%	Nutritive ratio—1 : 4·8.
Crushed Wheat	81%	
Meatmeal	9%	

For younger pigs, the ration utilised by the Muresk Agricultural College would be typical:—

Crushed Wheat	80%	Fed with 5lb. skim milk per pig.
Crushed Peas	20%	Nutritive ratio—1 : 4·3.

The experience from this and previous competitions* has shown that it is necessary to maintain the pigs in growth from weaning time until marketed. It is fatal to curtail the feed if the pigs appear to be growing too rapidly, as this causes a break in the fat and decreases the "eye" of meat at the loin.

The competitions also have shown that quality of meat, streakiness and fat are largely a matter of feeding, but that length, which West Australian pigs generally lack, can only be obtained by selecting suitable breeding stock

Regarding breeds, the competition has shown definitely:—*Firstly*, that there is no necessity to increase the number of breeds of pigs in the State beyond the Berkshire, Tamworth, and Large Whites. *Secondly*, that careful selection in these existing breeds is necessary to increase length, as, in all combinations of these breeds at present, both excellent and faulty pigs are found. *Thirdly*, it is extremely difficult to obtain increased length without sacrificing size and shape of hams. In the opinion of Mr. J. B. Swain of Empire Pork House, London, this step is warranted, and is one of the reasons why the Canadian or Improved Berkshire scores so well in Trade Classes. *Fourthly*, the recommendation of the Department of Agriculture that the Tamworth-Berkshire crosses are the most suitable for West Australian conditions and can supply a bacon or pork carcase suitable for the London market has been borne out by the three years' competitions

* Perpetual Executors Export Pig Trophy, 1934. Jour. Agric., June, 1935.
Pig Feeding Experiment on "Tipperary Farm," Burges Siding. Jour. Agric., Sept., 1936.
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THE FRUIT INDUSTRY IN WESTERN AUSTRALIA.

Fruit Production and Export.

Geo. W. Wickens,
Superintendent of Horticulture.

The season 1936-37 will go down in our records as being one in which great expectations have been followed by keen disappointments, and wherein "the hope that springs eternal" dried up like many other springs did in this droughty year. It will be remembered that when making a forecast of the apple crop in December last, I stated that in spite of heavy crops in the two years immediately preceding there was definite evidence in the fruit then actually on the trees that Western Australia would have the unusual experience of harvesting a still heavier one in 1937, and I forecasted an increase of 150,000 cases on the figures for 1936, which would have meant production amounting to 1,386,000 cases. The actual figures are not yet available, but it is abundantly evident that I failed badly as a prophet, for though sufficient fruit was on the trees at the time to make my estimate appear a certainty, a large quantity never reached the market. The first setback occurred when the fruit, owing to continued dry weather, failed to make a normal increase in size; then on 10th February a cyclonic windstorm swept the orchards throughout the State, uprooting trees and scattering the fruit broadcast. Following this, on 10th March, a record hailstorm devastated the orchards at Bridgetown in one of the most thickly planted areas in Western Australia, and even then the tale of destruction was not complete, for later in the year lesser storms ruined individual crops in the Mount Barker district, and the total losses of fruit owing to weather vagaries amounted to hundreds of thousands of cases.

Still, in spite of the vicissitudes outlined above, apple growers on the whole have experienced a satisfactory season, for though the quantity exported was less this year than last by 207,341 cases, upwards of 80 per cent. was purchased F.O.R. growers' sidings, and the prices paid according to variety ranged from 5s. to 7s. 9d. per case.

Pear growers suffered much more from the windstorm mentioned above than apple growers, many trees being swept bare of fruit, and I have to confess my estimate of the pear crop was just as much astray proportionately as that of the apple crop. In December I forecasted a crop equal to the one in 1936, viz., 113,450 cases. Actual figures are not yet available but the fact that the quantity of pears exported last year amounted to 45,785 cases, and this year to 31,111 cases, shows my estimate was well above the quantity harvested.

The four main kinds of fruit exported from Western Australia are apples, pears, grapes and oranges, and of these grapes only were shipped in greater quantities in 1937 than in 1936; in fact, the number exported in 1937, viz., 61,745 cases, created a record, the previous largest consignment being in 1935 when 57,482 cases were sent away. Colombo and Singapore received by far the major quantity with 26,194 cases and 17,608 respectively. One interesting feature in this year's export figures is the appearance for the first time in commercial quantities of grape fruit, 102 cases being shipped—45 to Colombo, 30 to Port Said, and 27 to Malta. Attached are full particulars for year ended 30th June, 1937, showing kinds of fruit, quantities of each, and destinations. In these are included 22,658 cases of apples, 410 cases of oranges and 30 cases of grape fruit shipped between 1st July, 1936, and 31st December, 1936.

Export of Fresh Fruit from Western Australia to Overseas Markets for year ended 30th June, 1937.

Destination.	Apples.	Pears.	Grapes.	Oranges.	Grape Fruit.	Lemons.	Peaches.	Plums.	Passion Fruit.	Nectarines.	Apricots.	Cherries.	Totals.
	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.
London	265,541½	22,139	2,027	1	—	54	—	57½	59	—	—	—	289,879
Hull	6,294	—	—	—	—	—	—	—	—	—	—	—	6,294
Southampton ..	16,562	—	384	—	—	—	—	—	—	—	—	—	16,946
Glasgow	63,692	21	394	—	—	—	—	—	—	—	—	—	64,107
Liverpool	77,571	594	300	120	—	—	—	—	—	—	—	—	78,585
Hamburg	76,471	1,269	1,350	—	—	—	—	—	—	—	—	—	79,090
Stockholm	77,325	5,472	2,141	—	—	—	—	—	—	—	—	—	84,938
Gothenberg ..	6,749	200	60	—	—	—	—	—	—	—	—	—	7,009
Rotterdam ..	15,015	—	—	—	—	—	—	—	—	—	—	—	15,015
Antwerp	4,873	—	—	—	—	—	—	—	—	—	—	—	4,873
Colombo	3,597	25	26,194	606	45	2	—	—	—	—	—	5	30,474
Port Said	29,484	—	200	100	30	—	—	—	—	—	—	—	29,814
Singapore	27,441	764	17,608	532	—	38	91¾	615¾	4	1	—	5	47,100½
Batavia	6,083	248	2,714	150	—	—	—	75	—	—	—	—	9,270
Samarang	1,001	35	1,044	63	—	—	—	—	—	—	—	—	2,143
Sourabaya	1,897	85	780	32	—	—	—	105¼	—	—	—	—	2,899¼
Penang	3,419	35	2,952	412	—	2	19	28	—	4	2	—	6,873
Belewan	319	6	328	—	—	—	—	—	—	—	—	—	653
Bombay	1,176	—	385	—	—	—	—	—	—	—	—	—	1,561
Madras	637	—	155	—	—	—	—	—	—	—	—	—	792
Aden	400	—	—	—	—	—	—	—	—	—	—	—	400
Palembang	90	—	—	7	—	—	—	—	—	—	—	—	97
Malta	323	—	—	53	27	—	—	—	—	—	—	—	403
Saigon	3,135	218	1,397	—	—	—	—	—	—	—	—	—	4,750
Rangoon	—	—	681	—	—	—	—	—	—	—	—	—	681
Macassar	100	—	40	—	—	—	—	—	—	—	—	—	140
Haifa	4,835	—	400	—	—	—	—	—	—	—	—	—	5,235
Durban	553	—	—	—	—	—	—	—	—	—	—	—	553
Tunis	1,525	—	—	—	—	—	—	—	—	—	—	—	1,525
Telaviv	5,500	—	—	—	—	—	—	—	—	—	—	—	5,500
Calcutta	359	—	211	—	—	—	—	—	—	—	—	—	570
Totals ..	701,967½	31,111	61,745	2,076	102	96	110¾	881½	63	5	2	10	798,169¾

Acreage and Production.

Returns showing the area devoted to orchards and vineyards in these days of increasing production and diminishing markets make interesting comparisons from year to year, and attached hereto are particulars for season 1935-36, the latest available.

Every kind of fruit shows an increase in acreage over that of season 1934-35. Most of the increases are quite small, only two exceeding 100 acres. These two are—apple trees which have increased by 313 acres, and orange trees by 119 acres.

Full particulars of acreage and production of all fruits, including vineyards, for season 1935-36 (latest figures available) are as follow:—

Acreage and Production of Fruit in Western Australia.
Season 1935-36.

ORCHARDS.

Kind of Fruit.	Area. Productive. Acres.	Unproductive. Acres.	Total. Acres.	Production. Bushels.
Apples ..	9,027	3,735	12,762	1,235,849
Apricots ..	606	89	695	62,088
Bananas ..	121	151	272	24,313
Cherries ..	25	16	41	56,108 lbs.
Oranges ..	2,571	412	2,983	323,676
Mandarins ..	152	35	187	15,563
Lemons ..	425	74	499	63,170
Other Citrus Fruit ..	19	20	39	1,932
Figs ..	331	60	391	43,089
Nectarines ..	161	57	218	16,838
Almonds ..	242	66	308	74,894 lbs.
Pineapples ..	7	8	15	841 doz.
Peaches ..	640	179	819	63,280
Pears ..	868	154	1,022	113,450
Plums ..	867	258	1,125	84,618
Quinces ..	77	13	90	8,195
Strawberries ..	28	—	28	50,750 punnets
Total ..	16,167	5,327	21,494	

VINEYARDS.

	Area. Acres.	Production. Cwts.
Table grapes	981	53,511
Wine grapes	1,525	41,483
Drying grapes	2,467	213,095
Not bearing vines	1,078	..
Total	6,051	308,089

Wine made from 1935-36 *Season's Grape Crop.*

	Gallons.
Distillation wine	120,420
Dry wine	158,192
Sweet wine	152,329
Total	430,941

Dried Fruit Produced from 1935-36 *Season's Grape Crop.*

	Lbs.		Cwts.	Qrs.	Lbs.
Raisins	677,930	=	6,052	3	22
Sultanas	1,063,964	=	9,499	2	20
Currants	4,385,826	=	39,159	0	18

Importation of Fruit Trees and Plants.

If further evidence were needed of the definite determination of growers to increase the State's area under apple trees it is afforded in the return showing numbers of young trees received from the Eastern States and inspected at the ports of Fremantle and Albany.

For the year ended 30th June, 1936, 15,269 apple trees were brought in, or enough to plant out 152 acres. Apparently, however, the frequent warnings issued regarding the danger of over-production has had an opposite effect to that intended and spurred growers on to make greater efforts, for the returns given below show that for the year ended 30th June, 1937, 31,929 apple trees were imported, being sufficient to plant a further 300 acres. And to make sure of an additional supply if and when needed, 15,000 apple stocks for working over locally were also introduced. Return quoted is as follows:—

Plant Diseases Act, 1914.

Return of Fruit Trees and Plants Inspected at the Ports of Fremantle and Albany for year ended 30th June, 1937.

Kind of Trees.	Fremantle.	Albany.	Total.
Apple	23,613	8,316	31,929
Apricot	2,357	62	2,419
Almond	3,257	28	3,285
Cherry	982	35	1,017
Fig	112	10	122
Lemon	2,762	4	2,766
Loquat	891	6	897
Grape Fruit	1,356	—	1,356
Nectarine	1,136	46	1,182
Orange	10,645	—	10,645
Peach	5,512	41	5,553
Persimmon	110	2	112
Pear	3,130	40	3,170
Plum	4,927	74	5,001
Quince	144	3	147
Mulberry	601	6	607
Walnut	816	3	819
Other Nuts	289	—	289
Mandarin	1,371	2	1,373
Cumquat	34	—	34
Gooseberry	829	12	841
Raspberry	1,073	12	1,085
Loganberry	250	12	262
Currant	445	60	505
Apple Stocks	15,000	—	15,000
Apricot Stocks	2,000	—	2,000
Cherry Stocks	500	—	500
Peach Stocks	14,000	—	14,000
Olive Cuttings	470	—	470
Citron Cuttings	5,000	—	5,000
Citronelle Cuttings	1,000	—	1,000
Ornamental	27,548	200	27,748
Bulbs and Roots	397,567	36	397,603
Total	529,727	9,010	538,737

Fresh Fruit Imports.

In the returns hereunder showing quantity and kinds of fruit introduced from the Eastern States it is interesting to note that the quantities sent to Kalgoorlie are not nearly so large, nor do they form by any means the major portion of the fruit consumed at that centre as apparently is believed by some of our growers; and if the latter concentrate on supplying quality products to the goldfields markets the fruit arriving by the Trans. train need not cause any heartburning.

Details are as follow:—

Importation of Fresh Fruit Inspected under "The Plant Diseases Act, 1914," for year ended 30th June, 1937.

Fremantle—			
Bananas	1,229	crates	
Pineapples	1,271	cases	
Nuts	6,674	bags	
Passion Fruit	1½	cases	
Tomatoes	5	cases	
Oranges	8	cases	
Grape Fruit	41	cases	
Lemons	10	cases	
Pawpaws	1	case	
Gooseberries	572½	cases	
Cherries	1,636½	cases	
Nectarines	15	cases	
			11,464½ pkgs.
Kalgoorlie—			
Bananas	5,335	crates	
Pineapples	128	cases	
Nuts	36	bags	
Passion Fruit	86	cases	
Tomatoes	2,710	cases	
Oranges	2,991	cases	
Mandarins	140	cases	
Grape Fruit	38	cases	
Cocoanuts	9	cases	
Lemons	843	cases	
Loquats	55	cases	
Gooseberries	66	cases	
Cherries	1,044	cases	
Strawberries	5	cases	
Apricots	331	cases	
Nectarines	1,545	cases	
Plums	923	cases	
Peaches	2,408	cases	
Persimmons	10	cases	
Pomegranates	25	cases	
			18,728 pkgs.
Albany—			
Bananas	272	crates	
Pineapples	3	cases	
Tomatoes	25	cases	
Oranges	89	cases	
Mandarins	15	cases	
Lemons	6	cases	
Gooseberries	6½	cases	
Cherries	5	cases	
Nectarines	1	case	
			422½ pkgs.
Carnarvon—			
Nil			Nil

Java is the main source from which fruit is received from overseas, and bananas the principal kind.

Particulars are as follow:—

Importation of Fresh Fruit under "The Quarantine Act," for year ended 30th June, 1937.

Bananas—	
In crates	3,225,700 lbs.
In bunches	900 lbs.
Pineapples	1,100 lbs.
Mangoes	300 lbs.
Nuts	173,834 lbs.
Total	3,401,834 lbs.

THE PEAT SOILS AND RELATED SOILS OF WESTERN AUSTRALIA.

NOTES ON THE OCCURRENCE AND PROPERTIES OF PEATS AND OTHER POORLY DRAINED SOILS IN THE SOUTH WEST COASTAL AREAS OF WESTERN AUSTRALIA.

By L. J. H. TEAKLE* and B. L. SOUTHERN.†

The Mediterranean climate of the South Western portion of Western Australia brings problems in agriculture which are unknown in countries where the rainfall is of better distribution. The natural growing period is confined to winter and spring months and summer crops are generally produced under irrigation or on moist land in the shape of peat or muck deposits which can be drained for agricultural use. Considerable public expenditure has been incurred in Western Australia on the development of lands for summer cropping and the problems arising in connection with the utilisation of peat lands and other related types of poorly drained soils are here discussed to provide a background for most economic development.

At the outset it seems advisable to define some of the terms used in the course of a discussion of peat lands.

Peat.—"Soil composed predominantly of organic material considerably decomposed but highly fibrous, with easily recognisable plant remains."

Muck.—"Soil composed of thoroughly decomposed organic material, finely divided and with few fibrous remains, and with a considerable amount of mineral soil material." Dachnowski (1919), a prominent American authority on peats, includes as peats the pulpy, sedimentary and macerated deposits, more or less colloidal in nature, and requires the organic horizon to be at least 8 to 10 inches deep and to contain *less* than 40 per cent. mineral matter. This definition seems most appropriate for use generally, but eliminates many soils conveniently called peats in Western Australia.

The conditions favourable for peat formation are water-logging, restricted drainage and aeration, and an abundance of vegetable matter. These generally pertain in basins of poor drainage or on moist, flat land with a rising or fluctuating water-table where flourish many aquatic plants, reeds, sedges, algae, mosses, grasses and certain types of shrubs and trees. The residues from the death of these plants are covered with water at least for a considerable period of the year and decay is inhibited by a lack of oxygen necessary for the activity of appropriate micro-organisms. Twenhofel (1926), p. 287, estimates that the rate of accretion of peat deposits, measured at a depth of 25 feet, is about one foot in 75 years. At the surface the rate of accumulation would be about three times as fast. Under many circumstances the rate of accretion is probably very much slower.

Peat deposits occur in all latitudes under all ranges of temperature but are particularly common in cold, humid climates. Giles (1930) estimates that 90 per cent. of the peat deposits of the world lie between the 40th parallels of latitude and the arctic circles. The deposits in Western Australia, therefore, contribute to the other ten per cent., and extensive development of peat lands would not be expected. In fact, most of the so-called peat in Western Australia is insufficiently rich in organic matter to be properly classified in the peat category. In the United States of America there are over 100,000,000 acres of peat land and about 200,000,000 acres are known to exist in Europe and Asia.

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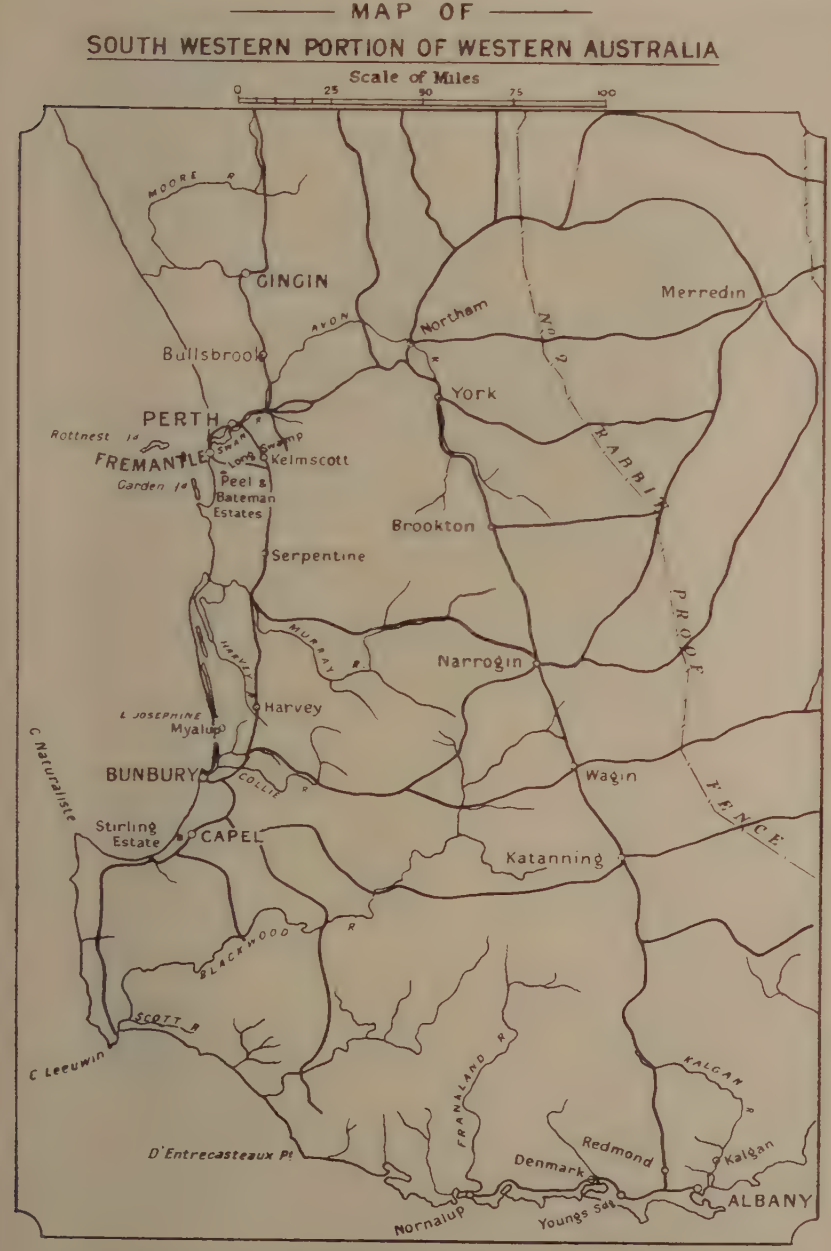

Fig. 1.—Sketch map of the South-Western portion of Western Australia showing the centres from which were obtained the samples of peats and related soil types described in this paper. In addition, the railway system, principal towns and rivers are shown.

No estimate is at present possible of the extent in Western Australia of peat lands and related formations, popularly known as "swamps," but the area must run into hundreds of thousands of acres if poorly drained types showing but a small accumulation of organic matter be included. The area of true peats would be small.

Some idea of the extent of these formations in the Western coastal areas may be gauged from the classification of the Peel Estates where, of a total area of 86,326 acres, some 8,000 acres have been classified as "swamp" lands. This is equivalent to nearly 10 per cent. of the area but is a higher proportion than obtains in the coastal formations generally, between Gingin and Cape Leeuwin, which are characterised by these "swamps." It is probable that upwards of 5 per cent. of the coastal sandhill zone could be classified as peats and related soils.

Classification of Peat.—In connection with mineral soils, classification is based on the properties of the profile or layers which develop in the course of soil formation, but the problem is far more complex with peats. Dachnowski (1920, 1924) has suggested that peats, too, should be classified according to the layers observed in section, although these layers would reflect stages in the history of the peat and could not be considered as a profile in the sense applied in the case of a mineral soil. This is known as the stratigraphical method and is much to be preferred to classifications based on vegetation association, chemical analysis or topography, as it may be regarded as the summation of all of these characters.

Three main groups of peat material may be recognised—

1. Sedimentary or pulpy peats—formed by the precipitation of colloidal remains;
2. Fibrous peat—from the accumulation of residues of reeds, rushes, sedges, mosses, etc.;
3. Woody peat—in which the woody remains of shrubs and trees constitute an important fraction.

One or more of these groups in various combinations may occur in a peat deposit.

In Western Australia by far the most important group in the Perth metropolitan area are the pulpy peats which occur in various forms in the numerous marshes. Particularly along the south coast, areas of more or less shallow fibrous peats occur, but important areas of woody peats are not known to the writers. Many so-called peats are really poorly drained sands and clays in which organic matter has accumulated.

Some Characteristics of Peat Soils.—In the formation of peat from the remains of plants very complex and poorly understood processes take place. The more readily available constituents are decomposed or altered to form stable complexes so that much of the total plant food is quite unavailable for crop growth. Furthermore, normal soil micro-organisms that ordinarily liberate these plant foods do not flourish in virgin peat and, after reclamation, their absence may be an important adverse factor in the production of crops. Peat, too, is very bulky and when dry, weighs only from half to two-thirds the weight of an equal volume of water. On wetting and drying great changes in volume normally occur, a fact of great importance in reclamation works. In many instances, the volume on drying is only from 10 to 40 per cent. of the moist volume and drainage may lead to very serious shrinkage of the surface level as well as to the formation of cracks which appear in the surface of drained marshes and interfere with cultivation and management. Under pressure, peat, particularly pulpy peat, tends to flow and roadways cause endless trouble on account of subsidence. In a similar manner drains tend to fill in owing to creep in the sides.

The moisture-absorbing properties of peats are well known, and are made use of for absorbing liquids in stables and to increase the moisture-holding capacity of certain soils in some instances. Relatively undecomposed sphagnum moss peats absorb from 15 to 30 times their dry weight of water; ordinary peats usually absorb water to the extent of 3 to 15 times their dry weight. Unfortunately, much of this water is unavailable to the plant and the pulpy types particularly do not give up their water readily. On this account they are often liable to drought and irrigation is of great benefit in connection with their agricultural development. After drying out to an air-dry condition a considerable degree of their normal water-holding capacity is lost and dried out peats may hold only one-third to half of their original figure. As the percentage of unavailable water is not likely to vary greatly, drying out seriously reduces the capacity to hold water in a form available for the growth of crops.

Peats, frequently carry a layer rich in iron sulphides, such as marcasite, at a depth of a couple of feet. This is apparently formed by the action of sulphuretted hydrogen, formed under waterlogged conditions, on the iron in the water. On drainage, the iron sulphides oxidise to form iron oxide (rust) and sulphuric acid, the first stage of the oxidation being ferrous sulphate and sulphuric acid. The sulphuric acid is frequently neutralised by calcium carbonate to form gypsum, or causes the development of soil acidity. Parts of Herdsman Lake give strong evidence of these actions.

Certain small crustaceans, molluscs and algae sometimes occur which accumulate calcium carbonate and lead to the formation of marly peats. Sponges and diatoms are of common occurrence, the former liberate siliceous spicules which, with the diatoms, are responsible for severe skin irritation known as "swamp itch."

Lake deposits and beds, occurring in limestone and drift sand areas northwards from Perth as far as Gingin, were examined by Simpson (1904) in 1903, who found many of them to contain commercially valuable Diatomite (Diatomaceous Earth) with finely divided organic matter.

The Agricultural Value of Peat.—Peat lands are generally cultivated for intensive crops such as potatoes, celery, onions, berries, maize and vegetables, but are used for pasture production, cereals and other purposes. Fenlands, a particular type of peat, are often exceptionally good potato and wheat lands. Record crops are frequently recorded from peat land, instances of which are the world record potato crop of 30 tons per acre grown by Zuckermann Bros. on the Sacramento River delta, California, and the Western Australian record of 23.85 tons from a measured acre on Mr. Kurt Martin's farm, Young's Siding, in 1928.

There are many types of peat, however, and some types are not at all satisfactory for agricultural purposes and will not lend themselves to reclamation. The fenland types and neutral, fibrous peats are generally valuable agriculturally when properly handled, but acid peats and colloidal, pulpy peats are generally doubtful propositions for reclamation projects. Regarding the pulpy or sedimentary peats, Dachnowski (1926) says that where over five feet deep they are relatively non-agricultural land and recommends their use as reserves for water, wild life, etc. Under reclamation, use for wild hay and pasture is recommended and provision for irrigation during dry periods is regarded as of paramount importance on account of the low available water capacity of the pulpy peats. The difficulty of handling this class of peat in Western Australia has been recognised by some farmers who have had to abandon their holdings on peat formations or have transferred their activities to the poor sandhill country which can be manured and watered to suit the crop without considering matters such as drainage.

In parts of America grain and stock farming on peat lands is found to be more profitable than market gardening, although the total production is considerably less.

In the treatment of peat lands for agricultural purposes drainage is the first essential and the water table should be reduced to a depth of 2 to 3 feet. On account of the moisture relations, irrigation should be made possible during dry periods to prevent the crop suffering from drought. Cultivation should be thorough, but to shallow depths only, and heavy rolling is necessary on open types. Excessive acidity must be corrected by the use of lime to bring the soil to between pH 5 and 6.5. In the case of alkaline peats, the use of sulphur is frequently beneficial.

Although peats are often very rich in plant foods and high in organic matter, liberal fertilising is usually necessary as these materials are more or less unavailable. Farmyard manure at the rate of 10 to 15 tons per acre to inoculate the peat with beneficial micro-organisms, regular green-manuring and the use of 5 to 10 cwts. of a complete fertiliser rich in potash are generally recommended in the preparation of peat land for crops. Special soil amendments such as copper sulphate and manganese sulphate have been found very beneficial in some instances.

The burning of peat lands is practised universally where agricultural development is being attempted, and a light surface burning is found to be beneficial to the succeeding crops. Deep burning is very deleterious and any burning causes the waste of valuable peat, lowers the surface, restricts the life of the formation, and enhances engineering problems.

Admixture of sand, clay and marl with peat soil is practised in parts of Europe with beneficial results and the reverse process, the use of peat as a dressing for sandy land of low water-holding capacity, has much to commend it and has been advocated by some in Western Australia.

The Coastal Swamps and Marshes of Western Australia.—The occurrence of swamp, marsh and wet heath lands in the coastal regions of the south-west portion of Western Australia has been described by Esson (1925) and Jutson and Simpson (1915). They occur in two environments—

(i) in depressions in the coastal aeolian sandhills, particularly along the west coast south of Gingin, and range from black sand, black clay, to peat and marly peat;

(ii) as more or less open heath plains, principally along the south coast as far east as Albany, in which poor drainage has caused peat accumulation on a sandy substratum.

Both types are to be discussed here but the second type has been examined by Hosking and Burvill and will be further described in a C.S.I.R. (Australia) Bulletin (in press).

Swamps and Marshes of the West Coast.

The swamps and marshes, or "lakes" and "swamps" as they are often popularly called, are an important feature of the coastal sandhill region south of Gingin and in the metropolitan area have been developed largely for market gardening and summer forage such as maize. Strawberries are grown at Bullsbrook.

Several distinct types of formation may be recognised:

1. Black organic sand to peaty loam formations occurring commonly in paperbark *swamps.

*A key to botanical names of plants mentioned is appended.

2. Black macerated, pulpy peat and peaty loams as occur on Mandogalup Marsh.

3. Black fibrous peat as occurs on portions of Herdsman "Lake."

4. Black colloidal, sedimentary or pulpy peat, more or less acid in reaction, as occur on marginal portions of Herdsman "Lake," on Richardson Marsh, etc.

5. Whitish, colloidal, pulpy, marly peat as occurs in the central portion of Herdsman Lake, on White Lake, Jandabup, etc.

6. Black clay formations as may be observed on Folly Flats, etc.

Of these types the black peaty sand and peaty loam appear to be most highly prized by gardeners; the black fibrous peat and the macerated pulpy peat are usually quite satisfactory for agriculture, but the colloidal types and black clay formations present considerable practical difficulties to agriculturists attempting reclamation.

Esson's (1925) work showed that the "peat" formations range from a few acres to hundreds of acres in extent, and from black humus sands to true peats in composition. Under the more sandy types lenses of coffee rock or alios are likely to occur; where peat accumulation has been more active or prolonged, 5 to 10 feet of peat is commonly met with, and it is known that over 20 feet of peat may occur in some marshes.

Generally, organic carbon is much lower than that required for true peats owing to the presence of quartz sand, kaolin, sponge spicules, diatoms, calcium carbonate and other inorganic materials. In many cases this is an advantage in improving the tilth of the soil. Nitrogen is generally on the low side relative to organic carbon as the carbon-nitrogen ratio averages 19.1 (60 samples). Phosphate is quite rich in some swamps but is very low in most instances except where liberal fertiliser treatment has enriched the surface layer. Potash is generally low.

In true peat formations, total water soluble salts are generally high according to standards for mineral soils but serious salt concentration is uncommon following reclamation. Gypsum is common in some types but is relatively innocuous, and ferrous and ferric sulphate occur in cases of excessive acidity. Soluble salts are usually low in the more sandy types.

Interesting cases of excessive acidity in the subsoil have been encountered and appear to be due to oxidation of iron sulphide following drainage of the peats.

In the course of the last 15 to 20 years quite a lot of information concerning these soils has been gathered, but no attempt has been made to bring it together and to evaluate it from the agricultural standpoint. Much of the data is somewhat sketchy and is difficult to handle with an appropriate measure of conciseness, but an endeavour is made to record it to provide as complete a picture as possible at the present time and to form a basis for further work. The information is collected in a series of tables and such descriptions as are available are given in the text.

1. *The Bayswater Swamps.*

In the Annual Reports of the Mines Department of Western Australia for 1925 and 1926, Esson (1925), Hoare (1926, p. 173) and Bowley (1926, p. 24), give some information regarding certain swamp lands in the coastal sandhills in the vicinity of Bayswater. These "lakes" occur at no particular elevation, as, at Bayswater, they range in elevation from 20 to 80 feet above sea level. In composition they range from black sand and peaty sand, which is mostly cultivated, to peat, only some of which is under cultivation. The organic matter is the residues of paper bark, swamp myrtle, reeds, bulrushes, bracken

fern, sedges, etc., and is frequently contaminated with sponge spicules, sometimes by diatoms. Some 10 formations were examined and ranged from 3 to 76 acres in area. The soil ranges from one foot deep in some cases to over 15 feet deep in the Hill Street swamp. Ten feet of water stood on the centre of Hayne Lake at the time of inspection.

The drained areas are used for market gardening and maize, potatoes, vegetables and strawberries are grown. Sprinkler irrigation is used in the summer.

Some chemical data for samples from Bayswater "lakes" are given in Table I.

TABLE 1.

CHEMICAL PROPERTIES OF SOILS FROM BAYSWATER SWAMPS.

Reference.	Swamp.	Ash.	Nitrogen.
		%	%
Esson (1925)	Hill Street, No. 1 ...	6·40	0·95
Bowley (1926)	Killarney	60·32	0·71
	Killarney	28·43	1·23
	Drake Street ...	61·39	0·61
	Railway Line ...	27·25	1·16
	Swan Lake	60·86	0·56

The ash of the samples reported on by Bowley (1926) consisted of sponge spicules, diatoms, quartz and kaolin.

2. Marshes of the Perth Metropolitan Area.

The Joondanna or Pitter Marsh. This small marsh lies about half a mile north of Herdsman "Lake" and is used principally for grazing and forage. A fair sward of couch grass, clovers, trefoil, and weeds have been established since the area has been drained and maize is grown as a forage crop. The peat is of the fibrous type, blackish in colour and generally ironstained in the subsoil. Owing to drift, sand is intermixed with the surface layers near the margins. Originally the area appears to have been a rush marsh, carrying bulrush and yanget and some paper bark.

Some properties of samples from this marsh are reported in Table 2.

Yambago Marsh, Osborne Park.—North West of Joondanna Marsh are a number of peat formations in the suburb of Osborne Park. These are of the rush type of marsh and following drainage have been developed sucessfully for market gardening. In the early stages of development, about 25 years ago, apparently results were not very satisfactory.

Where examined by the writers on November 14th, 1934, the soil was a rusty brown peat of the macerated, pulpy type but evidence of the colloidal, pulpy type was observed in the subsoils. The deeper layers appeared to be highly fibrous in nature. The water table was at a depth of about 2 feet.

Chemical information on some black fine sandy peats has been reported by Hoare (1926) and is included in Table 2.

Carenup Marsh, Balcatta.—Carenup Marsh was originally covered by a tussocky reed botanically different from the usual reeds in neighbouring marshes (bulrushes and yanget) and carried scattered paperbarks. It was developed successfully for market gardening about 30 years ago but now suffers from a rising water table. Some portions, once cultivated, are now submerged. One of the largest farmers on Carenup has transferred his activities to the sandy rises above the marsh on account of the expense of working peat land, but a number of other settlers are still producing vegetables successfully.

TABLE 2.

CHEMICAL AND PHYSICAL PROPERTIES OF PEATS OF THE PERTH METROPOLITAN AREA SAMPLED 14TH NOVEMBER, 1934 BY THE WRITERS AND OF SAMPLES REPORTED ON BY HOARE (1926).

Results expressed on the Oven Dry Basis.

Serial No.	Depth.	——	Loss on Ignition.	Organic Carbon.	Total Nitrogen.	P_2O_5.	K_2O.	† T.W.S.S.	NaCl.	pH.	Lime Requirement.*			C : N Ratio.
											to pH7.		to pH5.	
											$Ca(OH)_2$.	$Ca(OH)_2$ per acre.	$Ca(OH)_2$ per acre.	
	ins.	*Joondanna Marsh.*	%	%	%	%	%	%	%		%	foot tons.	foot tons.	
1223	0–10	Black humous sand ...	7·9	4·1	0·24	...	...	0·085	0·023	6·31	·060	0·5	*Nil*	17·2
1224	10–24	Blackish-grey and brown iron-stained fibrous peat	38·2	21·2	1·05	...	...	0·260	0·036	4·59	·645	5·8	0·9	20·1
1225	24–36	Blackish-grey fibrous peat	58·1	25·0	1·21	...	...	1·192	Trace	4·01	1·611	5·5	2·7	20·6
		Carenup Marsh.												
1226	0–18	Black muck	59·5	31·8	1·87	1·18	·116	0·60	·102	5·97	·165	1·5	*Nil*	17·0
1227	8–39	Black muck, fibrous and slightly gelatinous ...	69·9	37·4	2·18	0·33	·054	1·85	·153	4·49	·396	3·6	0·7	17·2
1228	0–15	Brown peaty loam from limonite formation ...	24·6	9·5	0·50	0·77	·040	0·12	·041	6·80	·309	3·6	*Nil*	19·0
1229	15–42	Black muck, as 1227 ...	76·1	44·8	2·23	0·09	·024	0·74	·177	6·09	·222	2·0	*Nil*	20·1
		Osborne Park (Hoare (1926)).									Total CaO.			
214	surface	Black fine sandy peat ...	37·4	16·4	0·85	1·08	·075	·180	·086	6·2	1·04	N.D.	N.D.	19·3
215	subsoil	do. do. ...	31·9	13·8	0·77	0·99	·056	·136	·089	6·4	0·58	N.D.	N.D.	17·9
216	surface	do. do. ...	64·1	24·4	1·58	0·16	·246	·614	·165	6·0	1·72	N.D.	N.D.	15·4
217	subsoil	do. do. ...	75·8	23·4	1·50	0·12	·129	·524	·148	6·0	1·37	N.D.	N.D.	15·6

* Using method of Puri and Anand (1934). † Total Water Soluble Salts.

The surface peat appears to be of the black, macerated pulpy type and at 15 to 18 inches deep rests on a soft fibrous somewhat gelatinous layer, also black in colour. A sandy bottom was encountered at 40 inches at one site.

In certain patches, a hard surface layer of limonite cement appears to occur in the surface peat. After removing the boulders of ironstone, the peat responds well to cultivation but is stained a rusty brown colour and exhibits a loamy texture.

Analyses of samples from two sites examined by the writers on November 14th, 1934, are reported in Table 2 on previous page.

The apparent Specific Gravity and water absorption by air-dry peat are recorded in Table 3.

TABLE 3.

PHYSICAL PROPERTIES OF PEATS FROM CARENUP MARSH.

(See Table 2.)

Water absorption as percentage of oven dried soil.

Serial Number.	Depth.	Apparent specific gravity air dry sample.	Water absorption after 3 days in contact with water. %
1226	0–18	0·73	324—very rapid.
1227	18–39	N.D.	192—very slow.
1228	0–15	1·08	210—very rapid.
1229	15–42	0·76	N.D.

From the information in Tables 2 and 3 it is seen that these peats are often too high in ash to be classed strictly as true peats but in most cases their behaviour is such that they may be conveniently regarded as such. The surface reaction is generally satisfactory but the subsoil is liable to be quite strongly acid and two sites show subsoil pH values between 4 and 5, and a lime requirement (to bring to neutrality) of 4 to 6 tons per acre foot. Phosphate is rich in the surface soils in most cases and probably reflects generous phosphatic fertilisation. Potash is generally low. Water soluble salts are not generally high and where high figures have been obtained, the dominant constituent is the more or less innocuous gypsum and not common salt. The ratio of carbon to nitrogen is consistently wide in all samples and averages 18.1 for the 11 analyses. It is probable that the availability of the nitrogen is low. Water-absorbing capacity is interesting in showing the lack of affinity between water and the somewhat gelatinous subsoil sample (Number 1227) when air dry. This seems characteristic of this type of peat, which falls in the colloidal, pulpy group, until cultivation and cropping has mellowed it. Water absorption by the other types of peat is very rapid.

3. *Soils of restricted drainage in the Peel and Bateman Estates.*

The Peel and Bateman Estates lie about 20 miles south of the Perth metropolitan area and are largely composed of the coastal sandhill formations. A large number of "lakes" and "swamps" occur and the most important of these have been drained by the Folly Main Drain, which runs from the north part of the Peel Estate through Mandogalup, The Spectacles, Richardson "swamp," etc., to the Serpentine Diversion which empties into the Peel Estuary.

The Folly Flats constitute another area of "swamp" soils and appear to be formed as a result of overflow from the Serpentine River. Partial drainage has been effected by diversion and control of the waters of this stream, through the Serpentine Diversion drain.

While successful farming has been possible in some cases, from the beginning difficulties have been experienced in the management of the various units of reclaimed swamp land and these appear to be related to (i) initial drainage difficul-

ties, (2) improper selection of crops, (3) physical properties of the soils in certain instances and (4) soil acidity in certain instances. Excess of water soluble salts is known to occur in some cases but does not appear to be very general.

Information regarding representatives of these areas is reported below.

a. *Richardson Swamp.*—The Richardson swamp is a bulrush-covered peat marsh of 350 acres. The surface peat is of the colloidal, pulpy type, brown and black in colour and, when first drained, was cemented into large lumps of a hard and brittle consistency. With cultivation and pasture establishment these lumps broke down and mellowed into a satisfactory structural condition. Below the surface peat, occurs a clayey muck to clay, more or less fibrous with roots, and at a depth of 3 to 4 feet a greenish and greyish marl is encountered. Near the margin, in some instances, the marly layer reaches the surface.

Analyses of samples from the area are reported in Tables 4, 5 and 6.

TABLE 4.

COMPOSITION OF PEATS FROM RICHARDSON SWAMP, RECEIVED 19TH JUNE, 1923, AND REPORTED ON 8TH AUGUST, 1923, BY GOVERNMENT MINERALOGIST AND ANALYST.*

Results expressed on the Steam-dried Soil Basis.

Location No.	Depth.	Loss on Ignition.	Organic Carbon.	Total Nitrogen.	P_2O_5.	K_2O.	CaO.	Salt. NaCl	pH.	Apparent Specific Gravity.	C : N Ratio.
	ins.	%	%	%	%	%	%	%			
84	0–6	69·0	33·1	1·06	·041	·110	2·38	0·71	4·5	·74	31·2
	6–12	66·0	32·0	1·24	·045	·104	2·18	1·08	4·5	·72	25·8
	12–18	67·8	22·3	1·12	·035	·081	2·22	0·95	4·5	·76	19·9
	18–24	16·9	8·5	0·39	·026	·345	1·31	0·24	5·7	·92	21·8
78	0–6	74·9	37·5	1·23	·042	·314	†2·35	1·05	6·9	·66	30·5
	6–12	67·9	32·6	1·19	·035	·154	1·70	1·16	6·2	·70	27·4
	12–18	47·8	23·3	1·06	·038	·263	1·41	1·65	5·5	·72	22·0
	18–24	26·8	13·2	0·56	·022	·236	†1·19	0·67	6·4	1·01	23·6

* File 818/22. † Samples contain some Carbonate.

Samples were examined by the writers on April 13th, 1931, and November 14th, 1934.

The reaction and salt (NaCl) content of samples representing the surface peat, the subsurface clayey muck and the marl are given in Table 5 and chemical and physical properties of samples taken on November 14th, 1934, are reported in Table 6.

TABLE 5.

DISTRIBUTION TABLE SHOWING REACTION AND SALT CONTENT OF SAMPLES FROM THE RICHARDSON SWAMP, SAMPLED 13TH APRIL, 1931, ON LOCATIONS 81 AND 170.

Figures indicate number of samples in each range.

Range of Reaction Values—pH.

Profile layer.	3–4.	4–5.	5–6.	6–7.	7–8.	above 8.	Total Samples.
Surface Peat	5	2	2	...	...	...	9
Subsurface clayey muck	3	1	2	1	...	1	8
Marl	...	...	...	...	4	1	5

Range of Salt Values—NaCl%.

Profile layer.	below ·10.	·10–·25.	·25–·50.	·50–·75.	·75–·100.	above 1·0	Total Samples.
Surface Peat	1	4	...	2	...	2	9
Subsurface clayey muck	...	...	5	2	1	...	8
Marl	1	2	2	...	...	...	5

The profile of the site samples was as follows:—

Sample 1230—0 to 15 inches—9 inches of dark grey loamy peat, mellowed by cultivation and pasture establishment on a brown gelatinous peat.

Sample 1231—15 to 30 inches—blackish grey clay.

Sample 1232—30 to 40 inches—greenish grey shelly marl.

Tables 4 and 5 show that certain samples of peat were high in salt at the time of the 1923 and 1931 samplings. No evidence of salt was observed in 1934,

TABLE 6.

CHEMICAL AND PHYSICAL PROPERTIES OF SOILS OF RICHARDSON SWAMP AND THE SPECTACLES, SAMPLED 14TH NOVEMBER, 1934.

Serial No.	Depth.	Loss on Ignition.	Organic Carbon.	Total Nitrogen.	P_2O_5.	K_2O.	* T.W.S.S.	Salt, (NaCl.)	pH.	Lime Requirement.			Apparent Specific Gravity.	Water Absorption after 3 days.	C : N Ratio.
										to pH7.		to pH5.			
										$Ca(OH)_2$.	$Ca(OH)_2$, per acre.	$Ca(OH)_2$, per acre.			
Richardson Swamp, Location 170.															
1230	ins. 0–15	% 48·0	% 24·31	% 1·34	% ·109	% ·072	% ·486	% ·145	5·84	% ·164	foot tons. 1·5	foot tons *Nil*	....	% 352 (very rapid)	18·1
1231	15–30	9·7	3·01	0·19	Trace	·970	·422	·133	5·45	·148	1·3	*Nil*	....	219 (very rapid)	15·8
1232	30–40	12·0	0·67	0·04	....	....	·967	·149	6·99	*Nil*	*Nil*	*Nil*	....	....	16·8
The Spectacles, Location 1152.															
1233	0–15	55·2	25·9	1·32	·038	·033	·179	·007	4·51	·598	5·4	0·6	·73	292 (slow)	19·6
1234	15–34	47·2	25·5	0·83	·034	·063	·393	·066	6·07	·168	1·5	*Nil*	·74	288 (rapid)	30·7

* Total Water Soluble Salts.

although the affected location was inspected. Furthermore, drainage was satisfactory as no water table was encountered to 40 inches as compared with 8 to 12 inches in April, 1931. The surface soils appeared to be strongly acid in the April 1931 sampling and certain areas may need liming. Treatment with the subsoil marl should be satisfactory. A wide carbon : nitrogen ratio of 23.0 is shown by the analyses of 11 samples reported in Tables 4 and 6. Pasture establishment appeared successful and should be encouraged.

b. *The Spectacles.*—The Spectacles is a bulrush marsh of 400 acres lying north of Richardson Swamp. It has been little developed agriculturally and in parts has suffered damage from fires. It is understood that over much of the area the peat is very shallow and rests on white sand. In November, 1934, the marsh was inspected at the north end, where some development was in progress. Here the virgin peat carried bulrush and bracken fern and was found to consist of 15 inches of dark grey gelatinous peat of the colloidal, pulpy type which rested on a black soft, fibrous peat slightly gelatinous in character. At 34 inches blackish clay was encountered and this rested on black sand at 38 inches.

The properties of this peat are given in Table 6 which shows the soil to be acid and also low in phosphate and potash and salt. Such areas should be suitable for pasture production if sweetened by the use of lime and liberally treated with fertiliser.

c. *Mandogalup Swamp.*—Although Mandogalup swamp, another bulrush marsh of 250 acres, is separated from the Spectacles only by a sand bank a few chains across, the soil is entirely different in character. The peat would probably be classed in the macerated pulpy group of Dachnowski, and the soil may be described as a loamy muck. It is high in ash, distinctly clayey in texture in the subsoil, and portions of the surface are very powdery when dry. When moist, the soil is greyish black in colour but it dries out to a dark grey. It absorbs water very readily and, in the field, is very permeable to water. The reaction is more or less acidic but falls generally within the satisfactory range for peat soils. Salt troubles are reported but do not appear to be general or serious, no doubt due to the permeability of the soil and good drainage. With respect to plant foods, the soils resemble other swamps in being low, but physically they are lighter, the apparent specific gravity being only about 0.5 as compared with 0.75. The carbon : nitrogen ratio averages 15.6.

The results of analyses of samples from Mandogalup swamp are reported in Table 7, page 344.

Mandogalup swamp is regarded as a suitable type for market gardening and pasture purposes, and satisfactory crops of maize, sunflower and sorghum for forage, and peas, pumpkins, potatoes and root crops have been produced. Summer irrigation appears less important than on many other swamps on account of the drainage, high permeability and good physical properties of the soil.

e. *The Folly Flats and Dog Hill Flats.*—Lying to the south of Richardson Swamp is a large area of about 15,000 acres, embracing a considerable proportion of flat, poorly drained country, which appears to have served in ages past as a settling pan for the overflow of the Serpentine River. The area is more or less oval shaped, about three miles wide on the east-west axis and 12 to 14 miles long on the north-south axis, and, in the virgin state, was covered by a low scrub of tea-trees (*Melaleuca lateriflora and M. uncinata*), *Kunzea recurrata*, *Calothamnus* sp., with scattered trees and clumps of trees such as flooded gum and swamp banksia (*B. littoralis*). More sandy formations on the margins carried paperbark, while the banks of coastal sand characteristically supported the eucalyptus-banksia association.

The soils of the flats are heavy dense clays showing more or less development of a columnar structure suggestive of the solonetz or solodi types. It is suggested

TABLE 7.

CHEMICAL AND PHYSICAL PROPERTIES OF SOILS FROM MANDOGALUP SWAMP.

Results expressed on the steam-dried soil basis

Serial No.	Depth.	Loss on Ignition.	Organic carbon.	Total Nitrogen.	P_2O_5.	K_2O.	CaO.	T.W.S.S.	Salt, NaCl.	pH.	Lime Requirement.			Apparent Specific Gravity.	Water Absorption after 3 days.	C : N Ratio.
											to pH7.		to pH5.			
											$Ca(OH)_2$, per acre.	$Ca(OH)_2$, per acre.	$Ca(OH)_2$, per acre.			
Mosedale's Block, 18th March, 1924.																
	ins.	%	%	%	%	%	%	%	%		%	foot tons.	foot tons.		%	
	Surface	34·6	....	1·12	·105	·070	†1·29	....	1·85	5·2	....	....	....	0·52	....	....
	subsoil	24·2	....	0·39	·020	·052	†0·89	....	1·42	5·8	....	....	....	0·62	....	....
Hogg's Block, 14th November, 1934.																
235	0–9	32·5	14·79	1·10	·145	·038	....	·114	Trace	5·43	·226	1·4	*Nil*	0·54	296 (very rapid)	13·4
1236	9–30	27·5	13·13	0·73	·045	·031	....	·128	Trace	5·43	·145	0·9	*Nil*	0·49	318 (very rapid)	18·0
1237	30–42	10·8	3·91	0·23	·026	·038	....	·066	·005	5·31	·178	1·1	*Nil*	....	229 (very rapid)	17·0
1238	0–9	36·0	15·98	1·27	·137	·049	....	·146	·008	4·85	·519	3·1	0·2	....	....	12·6
1239	9–33	27·9	12·76	0·75	·043	·018	....	·275	·008	4·95	·357	2·1	*Nil*	....	....	17·0

Note.—Analyses of 16 samples from Rowan's and Leslie's blocks in 1930 and 1931 showed a range in T.W.S.S. of 0·014 to 0·496%, the average being 0·20%, which represents the magnitude of the majority of the figures. Salt, calculated from chloride, was determined on 12 samples and ranged from 0·013% to 0·116%, with an average of ·04%. The reactions ranged from pH 4·03 to pH 6·46, but generally fell between pH5 and 6.

* File 818/22,

† Carbonate present.

that the materials are water-borne deposits from the Serpentine River which have been converted to magnesium clays, as shown by analysis, by the action of saline waters, and have acquired the unsatisfactory structure of solonised soils.

Marginal areas frequently show a surface contaminated by sand and accumulation of marl in the subsoil. On the Dog Hill Flats powdery soils are encountered.

The structure of the clays is unsatisfactory as, on drying, they form hard lumps which, in the surface layers, range from the size of peas to walnuts and which do not work down into a good tilth. When wet and waterlogged in the winter months, the clay runs together and puddles badly. Allowing access of stock when the soils are wet is deleterious on account of the susceptibility to puddling.

Some eight groups of soil types were recognised on the occasion of visits in February, 1936.

(i) sands on clays more or less marly in parts.
(ii) dark grey crumbly clays with more or less marly subsoils.
(iii) dark grey crumbly clays with sandy clay subsoils.
(iv) dark grey silty clay loams with sandy clay subsoils.
(v) dark grey and brown crumbly clay on hard sandy clay subsoil. These are the so-called *bungham* clays and are characterised by broad, shallow depressions, 6in.-12in. deep, known as crabholes, and which fill with water in winter. When dry, this type cracks badly.
(vi) dark grey sandy loams with sandy clay subsoil at 2 to 3 feet. This seems the most satisfactory agricultural land.
(vii) dark grey powdery loams on sandy clay subsoils.
(viii) grey to brown very light powdery loams on a sandy clay subsoil. A bar of sand may be interposed between the surface and subsoil and lead to low fertility.

Available information concerning the physical and chemical properties of soils from Folly Flats and Dog Hill Flats is reported in Tables 8, 9, 10, 11 and 12.

TABLE 8.

DISTRIBUTION TABLE SHOWING PROPERTIES OF THE SOILS OF THE FOLLY FLATS AND DOG HILL FLATS WITH RESPECT TO REACTION AND SALT CONTENT.

Figures indicate the number of samples in each range.

Range of Reaction Values— pH.

Depth.	below 4	4–5.	5–6	6–7.	7–8.	above 8	Total Samples.
Surface layer	...	3	6	5	...	1	15
To 24 inches	...	2	10	5	8	1	26
Below 24 inches	...	...	3	9	8	3	23

Range of Salt Values—NaCl %.

Depth.	below ·10	·10–·25.	·25–·50.	·50–·75.	·75–1·0.	above 1·0	Total Sample.
Surface layer	9	2	...	2	...	2	15
To 24 inches	8	7	5	5	1	...	26
Below 24 inches ...	4	4	8	6	1	...	23

TABLE 9.

Composition of samples of soil from Beaufort's block on the south end of the Folly Flats collected in the winter of 1932 by Dr. E. S. Simpson et al. (T.W.S.S. were determined by extraction of one part of soil with five parts of distilled water and filtering. The filtrate was evaporated to dryness with hydrogen peroxide and dried at 110°C.)

Depth.	*T.W.S.S. %	NaCl. %	pH.	NaCl to T.W.S.S. ratio.
0–4	·104	·030	5·11	·288
4–11	·148	·016	5·18	·108
0–7	·288	·145	4·97	·503
7–12	·444	·251	4·83	·565
0–7	·252	·109	4·97	·433
7–14	·240	·076	5·08	·316

* Total Water Soluble Salts.

TABLE 10.

MECHANICAL ANALYSIS OF SOILS OF THE FOLLY FLATS.

Serial No.	2017	2018	2033	2034
Group	3	3	5	5
Depth (inches)	0–3	3–12	0–4	4–18
	%	%	%	%
Coarse Sand	22·8	34·2	9·1	40·3
Fine Sand	7·7	8·2	6·3	10·9
Silt	11·1	7·2	19·1	8·9
Clay	49·4	44·7	53·7	34·6
Loss on acid treatment	1·4	1·4	1·6	0·9
Moisture	6·6	5·4	6·5	4·1
Loss on ignition	8·9	6·3	12·4	5·8

TABLE 11.

REPLACEABLE BASES OF THE SOILS OF THE FOLLY FLATS.

(Results on the oven-dry soil basis.)

Serial No.	Depth ins.	pH.	Clay. %	Milli equivalents per 100 Grams of Soil.					Percentage of Total Bases.			
				Ca.	Mg.	K.	Na.	Total.	Ca.	Mg.	K.	Na.
2017	0— 3	6·88	49·4	10·76	18·98	·52	1·51	31·77	34	59	2	5
2018	3—12	7·16	44·7	8·96	16·57	·51	1·84	27·88	32	59	2	7
2033	0— 4	5·52	53·7	5·41	15·86	·89	1·67	23·83	23	66	4	7
2034	4—18	5·33	34·6	3·18	10·33	·28	1·53	15·32	21	67	2	10

TABLE 12.

CHEMICAL PROPERTIES OF SOILS OF THE FOLLY FLATS.

(Results on the oven-dry soil basis.)

Lab. No.	Sample No.	Depth. No.	pH.	Nitrogen. %	Organic Carbon. %	Carbon Nitrogen Ratio.	Hydrochloric Acid Soluble.	
							P_2O_5. %	K_2O. %
... ...	1972	0— 3	5·22	0·133	2·93	22·0	...	...
... ...	1998	0— 3	5·92	0·249	3·77	15·1	...	...
... ...	1999	3—10	6·38	0·153	2·01	13·1	...	...
... ...	2011	2—27	7·53	0·048	0·47	9·8	...	...
... ...	2012	27—51	7·50	0·011	0·13	11·8	...	...
... ...	2017	0— 3	6·88	0·138	2·04	14·8	0·147	0·101
... ...	2018	3—12	7·16	0·067	1·04	15·5	0·086	0·092
... ...	2019	12—24	6·74	0·029	0·38	13·1	...	...
... ...	2033	0— 4	5·52	0·233	3·49	15·0	0·163	0·100
... ...	2034	4—18	5·33	0·074	1·29	17·4	0·060	0·044
... ...	2058	0— 6	5·00	0·258	4·14	16·0	...	...
... ...	2059	6—12	5·35	0·067	1·43	21·3	...	...

The outstanding feature of the results of these analyses is the high proportion of magnesium in the replaceable base fraction, particularly in relation to sodium. These are slightly developed structural alkali soils of the magnesium type, but in contrast with many wheat belt representatives of the structural alkali group, are low in exchangeable sodium. The explanation of the mode of formation of these magnesium clays is quite obscure at present, and it is regretted that further work on their peculiar and undesirable agricultural properties cannot now be attempted.

It was expected that the soils would be richer in organic carbon as their behaviour when wet would suggest a larger proportion of organic matter. In view

of the organic matter content being relatively low, it is possible that replacement of a portion of the magnesium with calcium, say, by gypsum treatment, would materially improve the soil structure and physical conditions generally. The carbon : nitrogen ratio averages 15.4.

Water soluble salts are somewhat high, but should cause no trouble if the land is properly managed. The reaction is very variable, but high acidity or high alkalinity was not encountered.

Agriculture has never prospered on the Folly Flats, and, at the present time, only poor pastures exist. Barley grass and giblet grass are the most prominent plants of any grazing value. Clovers grow on the light-textured soils (group vi), and silver grass, paspalum and hairy brome grass occur on certain areas. Kikuyu and couch grass may be observed on some marginal portions.

There is no evidence of a shallow water table, at least in the summer months, and the occurrence of a relatively dry layer at a depth of 5 or 6 feet in a typical site suggests that the effect of the winter rains is the chief factor in the excessive seasonal moistening of the surface soils. At this site water was encountered at 8½ feet, and rose in the hole to a depth of 7 feet. This water was quite saline, and contained 1.25 per cent. salt (calculated from chloride). Near the north bank a water table was found at a depth of five feet. The water was very salt, approximating sea water in salinity, and was found to contain 2.8 per cent. salt. Conductivity measurements showed that the water soluble salts were somewhat lower in chlorides than average subsoil waters of this concentration, but chlorides are the chief constituents. With salt water at depths as shallow as five feet some trouble from surface accumulation of soluble salts may be expected, and has been observed in the vicinity of this site. Elsewhere, on the Flats, there is little or no evidence of soluble salts except in marginal areas where a perched water table has formed, apparently the result of seepage from the surrounding sandhills.

Agriculturally, the soils of these flats are difficult propositions, but it is possible that improved results would be obtained if the surface water from the winter rains were controlled, surface drainage improved,* more suitable pasture plants established, and stocking confined to the months when the soils are dry enough not to puddle. Such heavy textured soils are generally unsuitable for arable purposes, and should be laid down to pasture.

The phosphate status of the surface soils appears to be relatively good (Table 12), but superphosphate must be recommended as a basal dressing in pasture establishment. To improve the physical condition of these magnesium clays, treatment with gypsum at the rate of about 1 ton per acre may be recommended. Magnesium clays such as these are of rare occurrence, and their reactions are little understood, but the presence of gypsum may be expected to improve the soils, both chemically and physically, and favour the growth of more satisfactory pastures.

About 4 miles west of Byford occurs an area of similar soil which, in the virgin state, carried a parklike distribution of sheoak (*Casuarina glauca*). Since improvement the clay soils carry a poor pasture, including hop clover, stinkwort, Guildford grass, etc. Doubtless, other occurrences are met with in the South-West coastal areas.

4. *Harding's Swamp, Bullsbrook.*—In connection with difficulties associated with strawberry culture, an investigation of Harding's Swamp, about 2 acres in area, was made on 14th April, 1931. The area had been cleared of rushes, paper-

* The use of the New Zealand mole draining plough has been recommended for this purpose.

bark, etc., and cultivated, but the drainage system was inadequate, and, even at the end of summer, the water table was high and ranged from one to two feet from the surface. Above the water table the soil was frequently very wet and soggy, a condition unsuitable for root development.

Over much of the swamp the peat was less than 20 inches deep, but the central portion was generally more than three feet deep. The peat was of the black fibrous type, and in marginal areas was mixed with a considerable proportion of sand. The bottom was either sand or sandy clay.

Analyses were made for reaction and chlorides, and the results summarised in Table 13.

TABLE 13.

DISTRIBUTION TABLE SHOWING REACTION AND SALT CONTENT OF PEATS FROM HARDING'S SWAMP, BULLSBROOK, 14TH APRIL, 1931.

Figures indicate the number of samples in each range.

Depth (inches).	Range of Reaction, Values—pH.						Total Samples.
	3·5–4·0.	4·0–4·5.	4·5–5·0.	5·0–5·5.	5·5–6·0.	Above 6·0.	
Surface	2	6	9	9	4	1	31
To 18	7	23	12	2	....	....	44
Below 18	2	5	18	8	....	....	33

Depth (inches).	Range of Salt content (NaCl from chloride), per cent.							Total Samples.
	Below ·05.	·05–·10.	·10–·20.	·20–·30.	·30–·40.	·40–·50.	Above ·50.	
Surface	14	11	5	1	....	....	....	31
To 18	29	9	5	1	....	....	....	44
Below 18	23	4	5	....	....	....	1	33

At a previous sampling three samples of surface soil (0-6 inches) were analysed with similar results, but two surface encrustations were very high in salt and gypsum. Apparently gypsum is the chief constituent of the water soluble salts and not chlorides.

From Table 13 it is evident that soluble salts are generally low in the soils and would not cause injury even to delicate plants. Practically all of the soils, however, are strongly to very strongly acid and this factor may be harmful even to strawberries. It would certainly interfere with the growth of peas and maize. Study of the results showed no relationship between the degree of acidity and the growth of the strawberries as is indicated by the information in Table 14.

TABLE 14.

RELATIONSHIP BETWEEN THE REACTION OF THE SURFACE SOIL AND THE CONDITION OF THE STRAWBERRY PLANTS.

Condition of Plants.	Reaction, pH.								Total.
	Below 4·0.	4·0 to 4·25.	4·25 to 4·50.	4·50 to 4·75.	4·75 to 5·0.	5·0 to 5·25.	5·25 to 5·5.	Above 5·5.	
Good to very good	....	1	2	....	2	3	3	....	11
Fair	....	....	....	....	2	....	....	....	2
Poor to very poor	1	....	....	1	1	2	....	....	5
Dead	1	1	1	1	1		1	2	8

It was observed that a strong odour of sulphuretted hydrogen was emitted from many sites during sampling. While the strength and occurrence of the odour showed no apparent correlation with the condition of the strawberries, it was concluded that this poisonous gas probably, and the poor drainage certainly, were factors associated with the unsatisfactory growth. Improved drainage would rectify the trouble and some attention to liming would probably be beneficial in this swamp.

5. *The Stirling Estate, Capel.*

The Stirling Estate, of some 10,000 acres, lies along the coast at the mouth of the Capel River. Some 3,000 acres of the Estate, lying on either side (north and south) of the Capel River channel, consist of swamp land. This was subject to flooding by the sea during high tides and rough north-west weather, but in 1913 was protected by floodgates, and flood waters and salt water controlled by banks or levees. Pastures, chiefly water couch, were established and the area has been used very successfully for fattening purposes.

In 1923 the floodgates burst during a heavy storm and the swamp was again flooded by sea water. The floodgates were repaired and strengthened by the Public Works Department and have proved adequate since that time. For three years after the repairs the pastures flourished, but since 1927 salt troubles developed and by 1930 some 200 acres were seriously affected and an investigation of the situation was undertaken by the Department of Agriculture.

The soil of the swamp is a dark grey to brownish muck usually more or less clayey in texture and could be regarded as belonging to the macerated pulpy type of peat soils. The subsoil is generally greyish but is often stained yellowish with iron oxide, and may contain iron oxide concentrations at a depth of about 2 feet. Below this, the soil is frequently highly acidic. Chemical analysis shows the peat to be unusually rich in plant foods, a fact to be associated with the fattening qualities of the pastures. The following results are reported from an analysis made in 1915. (5183/14.)

Loss on ignition	13.48%
Total nitrogen	0.462%
P_2O_5	0.189%
K_2O	0.385%
CaO	0.336%
Salt, NaCl	0.866%

Apparent specific gravity 1.20.

The content of salt is notable in view of later happenings. During the winter, the swamp land is covered by about 2 feet of fresh river water, but drainage reduces the water level to about 2 to 3½ feet below the surface during the summer months, and it would be expected that this leaching would effectively remove soluble salts. Perhaps the trouble, leading to this investigation, is related to the movement of salts toward the main drains, and this would be overcome with time and recovery hastened by improved drainage.

In January and April, 1930, samplings were made and a leaching and liming experiment arranged. A further series of analyses of samples from the experimental plots was made in January, 1931. The results of analyses are summarised in Table 15, page 350.

In the course of this investigation, it was observed that the reaction and salt content of the soils showed considerable variation. From low to very high salinities and from very acid to neutral reactions were obtained, but little relation to

TABLE 15.

DISTRIBUTION TABLE SHOWING REACTION AND SALT CONTENT OF SAMPLES OF SOIL FROM STIRLING ESTATE, CAPEL, SAMPLED 29TH JANUARY AND 1ST AND 2ND APRIL, 1930, ALSO 21ST JANUARY, 1931.

Date.	Depth of Sampling.	Range of Reaction Values—pH.							
		2—3.	3—4.	4—5.	5 6.	6—7.	7—8.	Total.	
January and April, 1930	To 12 inches	...	...	7	17	4	...	28	
	12 to 24 inches ...	1	6	1	17	1	1	27	
	Below 24 inches ...	1	4	6	8	2	...	21	
January 21st, 1931 ...	To 12 inches	...	...	8	36	4	...	48	
	12 to 18 inches ...	...	7	5	8	4	...	24	
	Below 24 inches ...	...	8	4	8	4	...	24	

		Range of Salt (Sodium Chloride) Content—Per cent.							
		Below 0·1.	0·1—0·25.	0·25—0·50.	0·50—0·75.	0·75—1·0.	1·0—2·0.	Total.	
January and April, 1930	To 12 inches	...	4	11	2	4	2	23	
	12 to 24 inches ...	...	1	6	7	5	...	19	
	Below 24 inches ...	2	...	6	5	4	2	19	
								Above 2·0	Total.
January 21st, 1931 ...	To 12 inches	...	7	14	11	1	11	4	48
	12 to 18 inches ...	...	6	7	5	4	2	...	24
	Below 24 inches ...	...	4	6	6	7	1	...	24

		Range of Content of Total Water Soluble Salts—Per cent.							
		Below 0·1.	0·1—0·25.	0·25—0·50.	0·50—0·75.	0·75—1·0.	1·0—2·0.	Above 2·0.	Total.
January and April, 1930	To 12 inches	...	...	4	5	1	2	...	12
	12 to 24 inches ...	...	...	1	...	5*	2	...	8
	Below 24 inches ...	...	1	...	1	3	2	1	8

* One sample was very rich in soluble iron.

the condition of the pastures could be observed in many cases. Apparently movement of salts and the moisture content of the surface soils were very important factors affecting plant growth, and seasonal information is not available in this direction.

Of very considerable interest was the observed tolerance of couch grass for soluble salts. At certain sites containing up to 1.0 per cent. salt (NaCl) this hardy grass was persisting and growing vigorously when the subsoil was relatively low in salt (0.09 per cent. at 27-30in.). The importance of the salt content of the subsoil in affecting the growth of water couch was also observed.

The reaction range in the surface soils was pH 4.37 to pH 6.41 and in the subsoils pH 2.72 to pH 6.72. The very high subsoil acidities are associated with ferruginous deposits and are the result of the oxidation of sulphide of iron which forms sulphuric acid and ferric oxide. The salt content generally ranges from 0.25 per cent. to 1.00 per cent. NaCl and shows no systematic variation with depth except where bare, crusted patches have formed.

With respect to salinity and reaction, the soils of the north side of the river were found to be distinctly different from those of the south side. Thus, at the time of the April, 1930, sampling, the salt content on the north side averaged 0.38 per cent. NaCl and the reaction pH 5.6. On the south side, the salinity averaged 0.83 per cent. NaCl and the reaction pH 4.5. The January, 1931, sampling showed a similar condition.

It seems likely that the difference is due to more frequent flooding of the southern side by the alkaline waters of the Capel River, which causes more effective leaching of salts and the neutralisation of excessive acidity.

As a result of the irrigation and drainage treatment on experimental plots, an estimated improvement of 20 per cent. in the growth of pasture on the plots was observed in the first year. Since then quite a satisfactory sward of water couch has been established on these sites but little improvement has been effected on the area as a whole. An extension of the irrigation and drainage system will be necessary to bring about reclamation.

6. *A Swamp Near Applecross.*

Situated about two miles south of the Applecross Wireless Station and in University Endowment lands, there occurs a swampy depression which is utilised as a nursery for pine seedlings. In 1928, it was observed that the mycorhiza—*Rhizopogon roseolus*—was not developing on some of the seedlings despite inoculation. Soil conditions were suspected and in consequence a close examination was made of the soil. Briefly, it was shown that the fungus failed to develop at soil reactions of pH 4.0 to pH 4.3, at pH 4.5 it developed only after a period of years, while it flourished at pH 4.7, the highest reaction found.

The soils of this area are composed almost entirely of quartz sand and contain, in the surface layers, from 2 to 6 per cent. of organic matter. The content of organic matter gradually diminishes with depth and fawnish and white sands are encountered at a depth of 27 inches.

The general fertility, as measured by hydrochloric and soluble constituents, is extremely low, while nitrogen figures range from 0.06 to 0.11 per cent. Prior to liming at the rate of one ton per acre, which stimulated the mycorhiza over the affected areas, the hydrochloric acid soluble lime figures ranged from 0.045 to .095 per cent. Brown coloured water draining from the area contained 130 parts per million of sodium chloride.

In the virgin state, the most prominent members of the vegetation associations were paper bark and rushes.

Table 16 gives partial analyses of selected samples taken 12 months after liming.

TABLE 16.

ANALYSIS OF SAMPLES FROM A SWAMP NEAR APPLECROSS, AFTER LIMING AT THE RATE OF ONE TON OF SLAKED LIME PER ACRE.

Hole Number.	Depth (inches)	Loss on Ignition. %	Nitrogen. %	pH.
3 ...	0–9	3·73	·056	6·1
26	0–9	3·37	...	5·0
26	9–18	1·40	...	4·7
26	18–27	·93	...	4·5
28	0–9	5·97	·110	5·5
28	9–18	1·83	...	4·4

7. *Miscellaneous "Swamps" of the West Coastal Areas.*

In order to place on record information about the soils of a number of poorly drained areas or swamps, information in Tables 17 and 18 is reported. The object in doing this is to show that the range of these soils is from black sands to black clays and the reaction is generally strongly acid to slightly acid. Calcareous formations occur and on these the reaction will be alkaline.

Soluble salts are generally low to very low, but high figures show that concentration may occur as the result of inadequate drainage or heavy texture.

The information in Table 18 shows these soils to be generally low in phosphate and potash and under agriculture would require liberal fertilisation as well as adequate drainage. Liming should be beneficial in many instances.

TABLE 17.

PROPERTIES OF POORLY DRAINED SOILS ALONG THE WEST COAST.

District.	Farmer.	Date.	Depth. ins.	Description.	pH.	Salt.
Serpentine	O'Rourke	August 3, 1932	0–9	Black sand	5·22	Trace
			9–21	Brown ferruginous sand	5·43	Trace
			21–30	Soft coffee rock	5·32	·008
		Do. do.	0–6	Black peaty sand	4·37	Trace
			6–12	Black sand	4·19	Trace
			12–30	Brown and white sand	4·40	·004
		Do. do.	0–10	Black sand	4·58	Trace
			10–25	Grey-brown sand	4·33	Trace
Kelmscott .... (Maize failure)	T. Bell	May, 1931	0–2	Black peaty sand	4·24	·16
			2–6	do. do. do.	5·30	·017
			6–12	do. do. do.	4·66	·033
			12–24	Brown sand	4·09	·017
(Maize successful)			0–2	Black peaty sand	5·72	·12
			2–6	do. do. do.	5·42	·017
			6–12	do. do. do.	4·90	·012
			12–24	do. do. do.	4·77	·006
Waroona	R. C. Cockburn, Murray Loc. 323	May, 1937	0–12	Dark grey clayey muck, very hard when dry; loss on ignition 14·2%	N.D.	·30
			12–	Dark grey clayey muck, very hard when dry, loss on ignition 14·2%, apparent specific gravity 0·78	4·76	·22
Peel Estate	Durrant	February 10, 1936....	0–3	Blackish-grey humous sand	5·99	·40
Corner Vale	....		3–10	do. do. do.	6·36	·08
			10–18	Brown and black sandy clay loam	5·80	·09
			18–36	Brown on white sand water table 36 in.	4·05	·05
		Do. do.	0–½	Dark grey crusty sand	5·70	2·33
			1–10	Dark grey humous sand	6·19	·15
		Do. do.	0–3	Blackish-grey humous sand	5·78	·74
			3–6	do. do. do.	6·18	·18
			6–20	Brown and black sandy clay loam	4·55	·31
			20–36	Brown on grey loamy water table, 36 inches	4·11	·10
		Do. do.	0–9	Blackish-grey sandy peat	5·55	·12
			12–30	Dark grey sandy clay loam	4·93	·15
			30–42	Brown on grey loamy sand, water table 40 inches	4·60	·03

TABLE 18.

COMPOSITION OF "SWAMP" SOILS IN THE HARVEY-BUNBURY AREA, FROM ANALYSES OF GOVERNMENT MINERALOGIST AND ANALYST, APRIL, 1924. (File 13/24.)

Area.	Settler.	Condition.	Soil.	Total Nitrogen.	P_2O_5.	K_2O.	CaO.	Water Soluble Salts.					
								T.W.S.S.	NaCl.	Ca.	Mg.	SO_4.	HCO_3 as $CaCO_3$
				%	%	%	%						
Myalup	Manning ...	Cleared	Black peat ..	1·078	·083	·039	2·175	0·492	0·309	·044	·044	·091	·08
	Piggott	Bulrush	do. ...	1·442	·073	·042	2·79	0·432	0·241	·044	·035	·115	·09
	Reading	do.	Loamy peat ...	0·280	·038	·032	1·142	0·242	0·143	·040	·026	·058	·06
	do.	Paper bark ...	do.	0·147	·021	·038	0·968	1·890	1·438	·243	·083	·255	·20
	Manning	do.	Black peat ..	0·987	·197	·078	2·730	0·750	0·500	·107	·031	·080	·40
	do.	Cleared	Marly loam ..	0·130	·042	·041	3·510	0·590	0·369	·087	·025	·066	·40
Long Swamp	Loc. 672 .	Blister bush ...	Loamy marl ...	0·182	·043	·059	0·590	0·207	0·099	·028	·019	·058	·12
	do.	Paper bark	Peat	0·826	·090	·038	1·30	0·370	0·269	·038	·020	·063	·10
Lake Josephine	Loc. 42	?	Calc. loam ...	0·700	·119	·099	36·81	3·032	2·448	·177	·116	·303	·46
	do.	Paper bark	do.	0·504	·074	·042	32·63	1·086	0·740	·071	·030	·058	·35

TABLE 19.

ANALYSIS OF PEATY AND RELATED SOILS FROM SCOTT R.*, EAST OF CAPE LEEUWIN, SEPTEMBER, 1922.

No.	A.		B.		C.		D.†		E.†		Plain Country.		Plain Country.	
Description	Tough "clay."		Tough "clay."		Fibrous peat.		Vegetable matter		Vegetable matter					
Colour	Dark grey.		Dark grey.		....		and white sand.		and white sand.					
Depth (ins.)	Surface.	Subsoil.	Surface.	Subsoil.	Surface.	Subsoil.	0–6.	12–18.	0–6.	12–18.	0–9	At 24.	0–9.	At 24.
Reaction	Alkaline	Alkaline	Alkaline	Alkaline	Alkaline	Alkaline	Neutral	Neutral	Neutral	Neutral	Acid	Acid	Acid	Acid
Loss on ignition (%)	64·6	28·2	34·9	15·9	80·5	75·3	53·2	23·7	28·6	10·3	20·5	9·8	21·6	18·1
Organic carbon (%)	44·2	18·2	18·6	4·7	59·9	58·6	38·4	10·8	23·7	5·66	14·9	5·8	7·2	4·9
Nitrogen (%)	2·31	·702	1·29	·53	2·44	2·46	1·73	·99	·72	·27	·563	·522	·470	·275
P_2O_5 (%)	·354	·077	·234	·082	·094	·109	·086	·045	·057	·027	·082	·043	·065	·038
K_2O (%)	·087	·045	·088	·129	·117	·073	·070	·031	·055	·027	·080	·072	·109	·114
Available K_2O (%)	....	....	....	....	....	....	....	....	....	....	·017	N.D.	·013	N.D.
$CaCO_3$ (%)	1·29	·48	5·62	·52	1·02	·54	·57	·09	·25	·17	....	....	....	....
CaO (other) (%)	4·44	1·70	2·03	1·05	1·95	2·56	1·13	·71	·41	·032	....	....	....	....
Salt (%)	·147	·060	·064	·025	·180	·160	·070	·033	·086	·069	....	....	....	....
Apparent specific gravity	·90	·87	1·06	1·27	·46	·65	·59	1·15	·76	1·17	·76	1·02	1·05	1·05
C : N ratio	19·1	25·9	14·4	8·9	24·6	23·9	22·2	10·9	32·9	20·9	26·5	11·1	15·3	17·8

* File 1154/22. † Soil from Bulrush Marsh.

Peats and related poorly drained soils of the South Coast.

Along the south coast of Western Australia from Cape Leeuwin, at least as far east as Esperance, are areas of poorly drained land, generally sandy, on which have developed soils more or less peaty in character at the surface. The range is from black sands to black and brownish peats, dark grey to black colloidal, pulpy peat and intractable black humous clays.

Various vegetation associations occur on these areas. Paper bark, tea-tree, and swamp myrtle occur on the more sandy swamp types, bottlebrush and associated shrubs grow on the poorer heath types, and "kangaroo" grass is characteristic of the better heaths where the peat is of the fibrous type. Some areas are very suitable for potatoes, the record crop for the State, 23.85 tons from a measured acre, being produced on Mr. Kurt Martin's farm at Young's Siding, near Albany. Some areas respond quite well to pasture establishment, and other areas have given quite disappointing results.

Another type of "swamp" land is found in the karri hills in the Denmark and Nornalup areas where deep, poorly drained valleys are important formations. The soils in these valleys range from black peats to brown peaty loams on a clayey subsoil and are normally water-logged throughout the year. These areas support a dense vegetation of sword grass, bayonet grass, and file grass with occasional swamp banksia and other trees.

The chemical properties of samples representing certain of these types of wet heath and swamp land are recorded in Tables 19, 20, and 21, pages 353-4.

TABLE 20.

ANALYSIS OF MISCELLANEOUS SOILS FROM "PLAIN" COUNTRY BETWEEN ALBANY AND DENMARK.*

Locality.	Young's Siding.		Group 113, Denmark.			?	Redmond.
Soil and depth	surface	subsoil	0–9	subsoil	Coffee rock at 36in.	Kangaroo grass flat. Fine black sand	Black fine sand.
Reaction pH	faintly acid	faintly acid	weakly acid	weakly acid	weakly acid	4·5	4·5
Organic carbon %	1·57	·54	4·34	·56	11·44	...	...
Nitrogen %	·109	·059	·140	·036	·333	....	....
P_2O_5 %	Trace	Trace	·020	·015	·027	Trace	Trace
K_2O %	·016	·016	·025	·015	016	Trace	Trace
$CaCO_3$ %	073	·046	·027	·020	·050	....	....
CaO (other) %	·012	....	·040	·009	·149	·04	·02
Total water soluble salts %	·046	·038	·019	·019	·050	038	·027
Salt %	·023	·020	·010	·010	·033	·036	·022
Apparent specific gravity	1·49	1·64	1·32	1 61	1·05	...	...
C : N ratio	14·4	9·2	31·0	15·6	34·4	....	...

* Files 2515/25 and 1432/28.

TABLE 21.*

REACTION AND SALT CONTENT OF VARIOUS PEATS AND RELATED SAMPLES FROM THE ALBANY DISTRICT—PER CENT. OVEN DRY SOIL.

District.	Farmer.	Depth.	Soil.	Total Water Soluble Salts.	Salt.	Reaction. pH
		ins.		%	%	
Lower Kalgan	H. C. Poole	0–4	Black peat	1·18	·50	4·07
		4–9	do.	·74	·19	4·31
		9–18	do.	·70	·20	4·38
Kalgan	G. Hill	0–9†	do.	3·15	·24	3·30
Young's Siding	T. H. Tonkin....	0–6‡	Grey marl	·55	·10	7·48
		6–12	Calc. peaty sand	·34	·04	7·34
				Water Soluble Iron. %		
			Moisture. %			
Albany	M. Hardie	....	....	....	....	....
	1090	Surface	146·5	·0009	....	3·40
	1091	8	208	·0012	....	2·53
	1092	18	157	·73	....	0·52
	1093	Surface	154	·0012	....	2·85

* Files 431/32. † Contains iron sulphide. ‡ Potatoes fail but grows cabbages and swedes.

With few exceptions, these soils are low to very low in phosphate and potash and, in some instances, are strongly acid in reaction. The abnormal reaction of the sample from Mr. Hardie's property, Middleton Beach Road, Albany (Table 21) showing pH 0.5 in the subsoil is interesting and indicates the extent to which oxidation of sulphides may reduce the pH value. It is also suggestive of the acid tolerance of certain sulphur-oxidising micro-organisms. Soluble salts are generally low—often extremely low—but some accumulation in more peaty and clayey soils is indicated by the figures in Table 21, page 354.

Further chemical information about the wet heath lands and the valley peats of the karri hills is presented and discussed by Hosking & Burvill in their paper on the "Soil Survey of a portion of the Denmark Estate" (in Press).

The utilisation of certain types of heath lands in the vicinity of Nornalup is discussed by Baron-Hay (1933), who concludes that, due to low fertility, development should be attempted in conjunction with better types of land. Drainage, fallow in the first year, the use of lime and superphosphate are necessary treatments and Yorkshire fog, cocksfoot and Lotus major are the most successful pasture plants. Other plants of some promise are kikuyu grass, paspalum, couch grass and water couch.

The swampy soils of the karri hills have been little developed, but, with effective drainage, should provide useful summer forage.

It must be concluded that much of the poorly drained plain country, where peat accumulation is slight, is of low fertility and should be worked in conjunction with better favoured soils. Where suitable peat accumulations occur, potatoes and pasture may be produced successfully under proper management.

The Composition of Water Soluble Salts.

For some unknown reason, obvious salt accumulations in soils are very generally referred to as "magnesia" by farmers in Western Australia. There is no known evidence, as far as the writers are aware, for the description of these salts as "magnesia," as the soluble salts are predominantly sodium chloride, and magnesia is of less importance. This is shown by the information in Table 22, page 356.

If the chlorides are assumed to be combined with sodium, then the salt content of the total water soluble salts ranges from 43 per cent. to 90 per cent. with an average of 63 per cent. Magnesium ion, on the other hand, averages 6 per cent. of the weight of total water soluble salts—or, to place on the same basis as salt, magnesium chloride would constitute 25 per cent. of the T.W.S.S. In the series reported the maximum as $MgCl_2$ would be 44 per cent. and the minimum 11 per cent. of the T.W.S.S. (total water soluble salts).

Summary and Conclusions.

In this paper the occurrence and nature of peat soils are briefly discussed as a foundation for the consideration of the peats and related soils of Western Australia. Many so-called peats in Western Australia do not meet the definition of peat but are conveniently grouped with that class of soil.

The peats and peaty soils of Western Australia occur most frequently in the coastal districts of high rainfall between Gingin and Esperance. They vary greatly in nature, chemical properties and agricultural value and an attempt has been made in this and a succeeding paper to bring together all the available data concerning peats and related soils in Western Australia.

The following points briefly summarise the conclusions drawn:—

1. While many peats and other soils of poorly drained areas in the coastal regions of Western Australia have proved very productive and valuable agricultural lands, there are many instances of unsuitable types for a variety of reasons, and reclamation for agricultural development should be undertaken with caution and only after thorough examination.

TABLE 22.

COMPOSITION OF WATER SOLUBLE SALTS IN POORLY DRAINED AREAS OF THE SOUTH-WEST COASTAL AREAS.

(Ratio of Na^+ : Mg^{++} in sea water is 8 : 1.)

District.	Block.	Water Soluble Salts—Per cent. Dry Soil.								Ratios.		
		T.W.S.S.	Salt from Cl.	Na^+.	K^+.	Ca^{++}.	Mg^{++}.	Cl^-.	SO_4^{--}.	$\frac{NaCl}{T.W.S.S.}$	$\frac{Mg^{++}}{T.W.S.S.}$	$\frac{Na^+}{Mg^{++}}$.
Bateman Estate	Blair	·466	·42	·133	·001	·003	·021	·255	·028	·90	·045	6·3
Peel Estate—Corner Vale	Durrant	·174	·095	·048	·002	·007	·009	·058	·068	·55	·052	5·3
Mandogalup	Vincent—											
	Surface	·366	·230	N.D.	N.D.	·059	·038	·139	·043	·63	·104	....
	Subsoil	·376	·260	,,	,,	·059	·031	·158	·045	·69	·082	....
Magenup	Watson—											
	Surface	·240	·110	,,	,,	·020	·011	·067	·043	·46	·046	..
	Subsoil	·186	·080	,,	,,	·020	·008	·048	·043	·43	·043	....
	Subsoil	·169	·080	,,	,,	·020	·007	·048	·025	·47	·041	....
Myalup	Manning	·492	·309	,,	,,	·044	·044	·187	·091	·63	·089	....
	Piggott	·432	·241	,,	,,	·044	·035	·146	·115	·56	·081	....
	Reading	·242	·143	,,	,,	·040	·026	·087	·058	·59	·108	..
	Reading	1·890	1·438	,,	,,	·243	·083	·870	·255	·76	·044	....
	Manning	·750	·500	,,	,,	·107	·031	·303	·080	·67	·041	....
	Manning	·590	·369	,,	,,	·087	·025	·224	·066	·63	·042	..
Long Swamp	Loc. 672	·207	·099	,,	,,	·028	·019	·060	·058	·48	·092	....
	Loc. 672	·370	·269	,,	,,	·038	·020	·163	·063	·73	·054	..
Lake Josphine	Loc. 42	3·032	2·448	,,	,,	·177	·116	1·48	·303	·81	·038	..
	Loc. 42	1·086	·740	,,	,,	·071	·030	·448	·058	·68	·028	..
									Mean	·63	·061*	

* Equivalent to $\frac{MgCl_2}{T.W.S.S.} = 0·25$

2. Evidence has been produced of the occurrence of fibrous peats, colloidal pulpy peats, macerated pulpy peats, peaty sands and loams and peculiar black magnesium clays.
3. Certain of these classes show difficult physical characteristics, high acidity is exhibited in some instances and the salt content is sometimes excessive. Magnesia is not known to occur as the dominant constituent of the water soluble salts.
4. Plant foods are generally low and the carbon : nitrogen ratio wide (average 19.1 for 60 samples), but examples of soils rich in phosphate and potash are reported. Liberal fertiliser treatment will generally be required. Liming is required in some instances.
5. Examples of excessive acidity have been encountered and are due to the oxidation of iron sulphides with the production of sulphuric acid and ferric oxide or ferric sulphate. In these instances pH values between 2 and 3 are common and a subsoil from Albany (Table 21) shows a low record of pH 0.52.
6. Proper attention to drainage is of paramount importance and summer irrigation is frequently desirable.
7. While certain areas are suited to market gardening when favourably placed with respect to metropolitan areas, it is considered that development for pasture purposes offers the best avenue for utilisation in most cases.

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KEY TO BOTANICAL NAMES OF PLANTS MENTIONED IN THE TEXT.

A.—TREES AND SHRUBS.

Paper bark	*Melaleuca pubescens*
Sheoak	*Casuarina glauca*
Swamp myrtle	*Agonis parviceps*
Bottlebrush	*Beaufortia decussata*
Swamp banksia	*Banksia littoralis*
Karri	*Eucalyptus diversicolor*
Flood gum	*Eucalyptus rudis*

B.—GRASSES.

Couch grass	*Cynodon dactylon*
Water couch	*Paspalum distichum*
Paspalum	*Paspalum dilatatum*
Kikuyu	*Pennisetum clandestinum*
Yorkshire frog	*Holcus lanatus*
Cocksfoot	*Dactylis glomerata*
Barley grass	*Hordeum murinum* *H. maritimum*
Silver grass	*Festuca bromoides* *F. Myuros*
Hairy brome grass	*Bromus villosus*

C.—CLOVERS AND RELATED LEGUMES.

Hop clover	*Trifolium glomeratum*
Giblet grass	*Lotus angustissimus*

D.—MISCELLANEOUS.

Bulrush	*Cladium sp.*
Yanget	*Typha angustifolia*
Sword grass	*Lepidosperma gladiatum*
Bayonet grass	*L. tetraquetrum*
File grass	*Lepidosperma sp.*
Kangaroo "grass"	*Evandra aristata*
Stinkwort	*Inula graveolens*
Guildford grass	*Romulea rosea*
Bracken fern	*Pteridium aquilinum*

THE FERTILISER ACT, 1928.

ADDITIONAL REGISTRATIONS AND A CORRECTION.

The last December issue of this Journal contains a list of the fertilisers registered for the current fertiliser year, together with the minimum percentages of the fertilising ingredients. Additional registrations, with their respective analyses, are shown in the following table.

The analysis of the Cresco brand fertiliser "Potato Special" which appeared in the previous list was not complete. This fertiliser is registered to contain 8.75 per cent. of water soluble potash in the form of sulphate of potash, and this ingredient was inadvertently omitted. The complete analysis of this fertiliser has, therefore, been included in the statement.

Name of Fertiliser.	Brand.	By whom registered.	Nitrogen (N) as:				Phosphoric Acid (P_2O_5) as:				Potash (K_2O) as:		Price per ton on rail at Works or Perth.
			Nitrate.	Ammonia.	Blood & Bone.	Bone-dust.	Water Sol.	Citrate Sol.	Acid Sol.	Total.	Sulphate.	Muriate.	
			%	%	%	%	%	%	%	%	%	%	£ s. d.
23% Superphosphate	Cresco	Cresco Fertilisers (W.A.), Ltd.	....	....	....	....	21·25	·50	1·25	23·00	....	....	3 12 6
High Grade Super. (23%)	ML in diamond	Cuming Smith & Mt. Lyell Farmers' Fertilisers, Ltd.	....	....	....	....	21·25	·50	1·25	23·00	....	....	3 12 6
Florida Superphosphate (23%)	Sickle	do. do. do.	....	....	....	....	21·25	·50	1·25	23·00	....	....	3 12 6
High Grade Super (23%)	CSML	do. do. do.	....	....	....	....	21·25	·50	1·25	23·00	....	....	3 12 6
Nitrate of Soda	Champion	A. Hicks	16·00	....	....	....	....	....	....	....	....	....	13 10 0
Muriate of Potash	Palestine	Geo. Wills & Co.	....	....	....	....	....	....	....	....	....	50·00	14 0 0
Phosphate of Ammonia	Floraphos	J. A. Newman & Co.	....	15·60	....	....	31·20	....	....	31·20	....	....	35 0 0
Blood and Bone	MAB in diamond	J. E. Shaw	....	....	6·0	....	....	....	12·00	12·00	....	....	10 15 0
Do.	P over BB in triangle	A. Hicks	....	....	5·0	....	....	10·00	5·00	15·00	....	....	10 0 0
Do.	Apollo	J. Kitchen & Sons	....	....	7·75	....	....	....	9·00	9·00	....	....	9 5 0
Do.	KBM	R. Bates	....	....	5·00	....	....	....	9·00	9·00	....	....	8 10 0*
Bone Dust	do.	do.	....	....	3·00	....	....	....	18·00	18·00	....	....	7 0 0*
Potato Special	Cresco	Cresco Fertilisers (W.A.), Ltd.	....	4·00	....	....	12·50	·50	·75	13·75	8·75	....	8 5 6

* At Kalgoorlie.

RAMS—THEIR IMPORTANCE IN FLOCK IMPROVEMENT.

HUGH MCCALLUM,

Sheep and Wool Adviser, Department of Agriculture.

In flock improvement, the careful selection of rams plays a very important part. Purchases should be made from one of the registered stud breeders who are, in the majority of cases, men who have made an exhaustive study of sheep breeding, and who at least, have a far wider range of experience than the average farmer dealing in sheep. Thus by purchasing rams from these breeders the farmer, apart from obtaining the requisite supplies, is gaining invaluable experience in the selection of good rams, and is generally assured of obtaining sires of sound constitution.

This quality in sheep is of fundamental importance, and without it no farmer can hope to improve his flock successfully.

There is yet another advantage to be gained from the system of registered breeding. Flock owners by referring to the register of Merino Stud flocks are enabled to select and purchase from a breeder whose flock was founded on a blood strain akin to that to which his own breeding ewes belong.

When once a breeder has been selected whose rams give satisfactory results, it is advisable to make annual purchases from him, and if this policy is adhered to, the benefits will soon be apparent in the improvement of the flock, providing of course, that the sheep are regularly culled and evenly fed.

However, the selection of the correct type of rams requires a great amount of consideration and is not a transaction to be performed hastily. The outstanding weaknesses of the breeding ewes should be carefully noted, and then rams should be chosen which are particularly outstanding in the points of deficiency of the ewes, and by this means these faults will be corrected.

The official register of Merino Stud flocks is issued annually throughout the Commonwealth by the central organisations of stud breeders.

False economy in the purchase of stud sires is a grievous mistake and one which is very often made by farmers. Temporary savings are accomplished, but losses ultimately prove this initial economy to be unjustified. Just as a well sired flock will improve, it is equally true that the flock will deteriorate if mated to rams of inferior quality. The presence of good rams in a flock is evidenced by the good covering of their progeny and the body and style of the fleece. If this matter was attended to the presence of so many characterless Merino clips on the market floor would not be by any means so prevalent.

During September and October the leading stud breeders of the State will be conducting their annual sales at which high class Merino, British breeds and Corriedale rams will be offered. Farmers should make a point of attending these sales as not only do they provide an opportunity of obtaining good sires for the flock, but they are of high educational value as they teach growers both the art of assessing relative values in sheep and also give them practical examples of the type of sheep which they should strive to breed.

Farmers are recommended to refer to an article which appeared in the issue of this Journal of June, 1935, pp. 151-153, dealing with "General Points in Selecting a Ram." This article has been reprinted in the form of a leaflet, No. 448.

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28-30 Forrest Place (opp. G.P.O.), Perth

Telephones: B 4376 and B 9121.
Cable and Telegraphic Address—"TOURIST PERTH"

Branch Offices:
Victoria Quay, Fremantle. Tel. L 2412.
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SEYBERT J. HAYWARD, Director.